A CONCEPT OF PRODUCTIVE SOCIETY
INTERPRETED BY INDUSTRIAL ARTS TEACHERS

BY

© Leslie L. Lewchuk

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION

DEPARTMENT OF INDUSTRIAL AND VOCATIONAL EDUCATION

EDMONTON, ALBERTA

FALL, 1969

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned hereby certify that they have read and recommend to the Faculty of Graduate Studies for acceptance a thesis entitled The Concept of Productive Society Interpreted by Industrial Arts Teachers, submitted by Leslie L. Lewchuk in partial fulfillment of the requirements for the degree of Master of Education.

Abstract

The study reported here was conducted to measure the opinions possessed by industrial arts teachers of Alberta, concerning the concept of productive society. An instrument (Opinionnaire of Productive Society) was constructed from the criteria used to describe productive society. These criteria, better known as the characteristics of productive society, were derived and structured from an extensive review of literature from the fields of Sociology, Industrial Psychology, Science, Education, History, Industrial Engineering, Management and Economics.

The Opinionnaire, based on the characteristics of productive society, required the teachers to give their opinions in two ways:

1. Determine from pairs of characteristics which one was most important when teaching industrial arts.
2. Determine which description of each characteristic was most important and which one was least important when teaching industrial arts.

The instrument underwent revision as a result of a pilot study. The Opinionnaire on Productive Society was administered to industrial arts teachers who were randomly selected from a stratified sample of industrial arts teachers for the Province of Alberta. The subgroups in the sample showed significantly different responses. Standardized

scale values showed a wide variation of response which created an unpredictable pattern of opinions. Correlation values between the various subgroups were low (.676 to -.410; only a few values exceeded .350).

It was concluded that significant differences do exist among teachers regarding certain parts of curriculum content, in this case content related to productive society. The results of this study revealed that certain characteristics of productive society which are emphasized in the industrial arts curriculum for Alberta were not considered to be important toward teaching industrial arts. This suggests that the objectives of industrial arts are perhaps not being met.

TABLE OF CONTENTS

CHAPTER	PAGE

CHAPTER PAGE

LIST OF TABLES

LIST OF FIGURES

FIGURE		PAGE

FIGURE PAGE

ACKNOWLEDGEMENTS

The author wishes to express thanks to his committee chairman, Professor J. E. Gallagher, and to the other members of the committee, Dr. R. S. Patterson and Dr. R. A. Bigsby, for their suggestions, guidance and constructive criticisms.

Appreciation is expressed to Mr. E. Jarkat for his time and interest in this study and for his continued assistance throughout.

A very special thanks is also expressed to Mr. M. W. Petruk for his assistance and interest which was of the utmost value.

Special recognition goes to Mrs. N. J. Phillips for her long hours in typing and organizing of the text material.

Finally, the author expresses appreciation to his wife, Sylvia, for her valuable assistance, patience and encouragement during the preparation and execution of this investigation.

Chapter I

Introduction and Purpose of This Study

Preface

There is general agreement among sociologists, scientists, historians, economists, and educators that the impact of scientific and technological change has had profound effects upon society and human values. Through new scientific discoveries, technological innovation was possible which resulted in a new kind of materialistic way of life on the North American continent. It was also felt that education was of prime importance for each individual if he was to understand and take advantage of the changes that were so prevalent in the productive type of society in which he lived.[1]

The understanding of the concept of productive society was recently introduced into the educational objectives in the province of Alberta. It was the purpose of this study to attempt to find out how industrial arts teachers interpreted productive society. It was assumed that the way teachers interpreted productive society would influence the mode of instruction used. Before measurement could take place, some kind of criterion had to be made

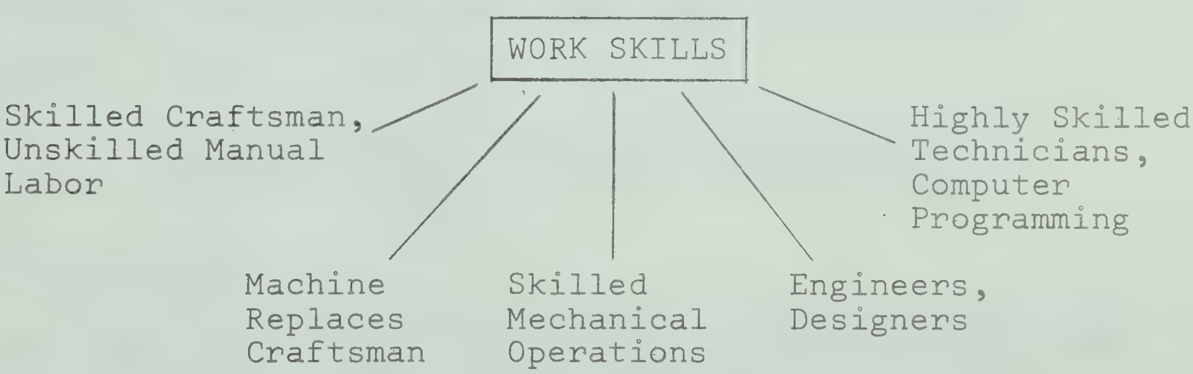
---

[1]This statement was based on the writings of Galbraith (1967), Venn (1964), Caplow (1954), Moore (1965), Michael (1962), Ginzberg (1964), Dawson (1957), and Conant (1948).

available upon which an instrument could be constructed. For the purposes of this study the concept of productive society was organized into certain identifiable characteristics.[2] The sum of these characteristics constitutes the explanation of productive society. Before defining and listing these characteristics, some insight into productive society may be gained by examining information which has a direct effect on productive society. Each section of information is inherent in all parts of productive society

---

[2]The characteristics were extracted from a review of literature and organized to form the concept of productive society. The characteristics were then used to form a basis for measurement. An example of a characteristic might be: Work Skills--which range from simple manual tasks to complex skills needed to perform highly technical work. A description of work skills might be shown as follows:



Measurement can then be based upon this description to find out how industrial arts teachers interpret this particular characteristic by indicating which part in the description is most important to them. Certain concepts have influenced the description of these characteristics, some of which include material and machine inventions, technology, methods of production, systems of cybernation and automation, and others, all of which are part of productive society. The study will attempt a brief introduction to productive society to place it in its proper perspective before details and methodology are outlined.

that one might study. The sections include: change, social environment, technological change, and educational influence.

Introduction

Change

Since the beginning of the first Industrial Revolution[3] man has not ceased in his attempt to control the environment. The machine became a product of human ingenuity and effort, and to understand the machine was a step toward understanding and remaking cultural[4] patterns.

Man's work patterns in North America are based on the productivity of goods and services for human consumption, either directly or indirectly. The methods and techniques by which productivity has been revolutionized have had pervading effects upon human civilization. Mulloy (1957, p. 7) noted:

> The inventions introduced by the scientific revolutions of the past two centuries have

---

[3]Many writers feel that the Industrial Revolution of 1750-1830 was not the only form of industrialism that was most significant. The factors of mass production, automation and cybernation could also be significant forms of an Industrial Revolution which changed society in some way.

[4]For the purposes of this study: Culture according to Hilton (1966), Vincent and Mayers (1959), and Miller and Form (1964) refers to a common way of life where communication, tools, machines, literacy, technology, human thought and creativity are all part of man's environment. Hilton refers to the term "cyberculture" as a way of life in a modern industrial society.

> transformed the face of nature and of human society, and in all five continents people are being moulded by the standardizing influences of a technological civilization.

Mumford (1934) pointed out that inventions in methods and techniques of the last century were not only technological in nature; there was also a change of mind, i.e. before any new industrial process could take place there had to be a reorientation of human habits, wishes, and values.

The tremendous growth of technology caused many developments in industry, to a stage where industry became the centerfold of society. K. E. Dawson (1964, p. 236) indicated that:

> We live in an era often referred to as the technological age. Technology and industry continuously influence our way of life. From the time of man the hunter, the trader, the builder, the manufacturer, the mass producer up to the time of man the programmer, we can see the various stages of technological development. Today this term is unique because society has become more aware of the complex integration of man and machines, of ideas, of industrial procedure, of management, and of the necessity to conquer the unknown.

K. E. Dawson (1964) and J. A. C. Brown (Ziel, 1964) pointed out that industry is the most dominant characteristic of North American society today because it is the single most important factor that contributes to the economic stability of these countries.

Technological Change and New Methods of Production

Productive society has been successful because technology has been used widely for the purpose of improving

industrial techniques which in turn have changed man's material environment. As K. L. Neff (1962, p. 23) stated:

> Technology, refers to applied science, i.e., the application of scientific knowledge to one's environment for the purpose of altering its form, substance or the way in which it is used. Technology is a product of man's individual and collective response to his environment.

Technology was used by social scientists and economists to describe and plan the future in terms of technological progress. Technology "spelled" increased productivity and improved the economic situation. As Fabricant (1965, p. 3) indicated: "Technological change is a major source of the improvement that has taken place and continues to take place in man's economic welfare."

Since the inception of modern technology, new methods of production and production control have been devised by man in an attempt to lighten his burden in all phases of work. John Diebold (Burke, 1966) noted that automation brought about tremendous changes in methods of production by introducing such factors as:

1. Detroit automation--mass production on an assembly line basis.
2. Computers--use of electronic systems.
3. Numerical control--direction of machines by the use of tape and other automatic control devices.
4. Process control systems--computers and integrated electronic systems.

The principle of feedback was employed to design machines

that did not have to take into account the limitation of a human worker. This was one of the distinctive aspects of automation. Machines were designed to perform operations in a very rapid sequence for a considerable length of time. This developed to the point where today most human operations are performed by operating buttons and controls that are connected to automatic devices. Diebold (Philipson, 1962, p. 26) suggested:

> Automation is more than a series of new machines and more basic than any particular hardware. It is a way of thinking as much as it is a way of doing. It is a new way of organizing and analyzing production process as a system and a consideration of each element as part of a system.

To further improve the efficiency and productivity of industry, cybernated systems were developed which coupled computers and existing automated systems. D. N. Michael (1962, p. 6) noted:

> Cybernated systems perform with a precision and a rapidity unmatched in humans. They also perform in ways that would be impractical or impossible for humans to duplicate. They can be built to detect and correct errors in their own performance and to indicate to men which of their components are producing the error.

According to Michael (1962), rising production costs, foreign competition, and a concern for increased sales and profits caused industry to turn to additional technological invention to increase productivity at a reduced cost. Cybernation has become that technological invention. Millions of dollars are spent to mechanize operations, boost

output and cut costs.

Social Environment

W. E. Moore (1965) and J. K. Galbraith (1967) noted that industry refers to the fabrication or production of goods or finished products by utilizing raw materials and mechanization.[5] Massive industrialization has contributed to economic growth and development which has far exceeded any level that our society has known. According to Galbraith (1967) the industrial system closely identifies itself with the goals of society. The industrial system, based on societal goals, established its own aims of efficient production of goods, steady expansion of output and physical facilities, and insures a sufficient supply of trained and educated manpower. Industry's goals are not a result of man's environment but are assumed to be a part of "human personality."

According to D. Riesman (Burke, 1966) the sudden onrush of leisure time has caused a creation of new wants and the economic stability of a family unit is not prepared or able to assimilate these wants. Riesman stated that

[5]According to Klemm (1964) and Wik (Kranzberg and Pursell, 1967, Vol. II), mechanization refers to operations which are performed by machines, and not by hand. Industry began to adopt various machines to increase output, and improved mechanization resulted in the use of various controls and technical innovations that still further increased production output. Man's energies were then channeled to more manipulative aspects rather than "back breaking" jobs that were prevalent in earlier times.

education has not prepared people to cope with this new kind of situation.

What about social impact of automation and cybernation? What will happen to the workers who are displaced by machines? Do people understand this change and are they equipped for it? D. N. Michael (1962, p. 41) asserted that:

> Education must cope with the transitional period when the disruption among different socioeconomic and occupational groups will be the greatest and the later relatively stable period if it comes to exist when most people would have adequate income and shorter working hours.

The problem of a rapidly changing world, particularly by industrialization and modernization,[6] has caused a need for deeper re-examination of the factors that control socialization. Neff (1962, p. 1) indicated that:

> Deeper understanding of the forces affecting long term economic and social progress is leading to recognition of the fact that investment in education is an indispensable prerequisite of future economic growth.

Educational Influence in Productive Society

Education becomes an important consequence because each person, particularly youth, should become familiar with the structure and function of an industrial society. D. G. Moore (Ziel, 1964, p. 85) suggested that:

---

[6]Modernization, according to Moore (1965), involves the adoption of the latest and most modern procedures of administrative and urban organization, communication, education, public health, occupational placement, transportation, and important industrial techniques. Modernization may be political, social or economic in nature.

> More education is needed, to be sure, but not so much in the way of getting people jobs in organizations of diminishing opportunity as it is a way of generating new and exciting activities and opportunities. A society is likely to grow and develop because it has a highly educated citizenry that is not only creative but also capable of implementing its ideas. Until we have these visions, everything else we do is mere patchwork.

General education became the single most important agent where individuals could grasp the idea of the changing environment and the influence of industrialism. According to Melvin Barlow (Ziel, 1964, p. 112):

> Technological society is highly sensitive to the prescriptions compounded by educational leaders who see clearly that education of a society must reflect in its content the elements appropriate for all of society.

Max Weber (Gerth and Mills, 1964) noted that specialization and a narrowing of skills is becoming most important in the work environment. However, Weber noted that the importance of general education cannot be overemphasized. Awareness of environmental forces that influence the work situation should be made clear to every member of society. Tiedeman (Ziel, 1964, p. 168) stated:

> Part of the educational process is to guide the person so that he comes out as the elector of this narrowing rather than the victim of the narrowing.

James B. Conant (1948) noted that the public schools serve as an important agent in providing education in the social process, humanities, natural sciences and career opportunities. Grant Venn (1964, p. 1) pointed out that:

> Technology has created a new relationship between man, his education, and his work, in which education is placed squarely between man and his work. Modern technology has advanced to the point where the relationship may be said to exist for all men and for all work.

Emerson (Ziel, 1964) and Dawson (1964) considered industrial arts as one subject area in curriculum development that can begin to illustrate and provide a basic understanding of the relationship between man and the industrial environment. According to Emerson (Ziel, 1964), industrial arts should be devoted to the interpretation of industry which is the most important characteristic of modern North American society. Emerson added that industrial arts should be acquainting individuals with the kinds of activities that are inherent in modern industry so that a wider scope of education could be made available to the members of a society. He noted that this type of education "goes far beyond teaching woodwork."

<u>Summary</u>

Certain concepts of change, technological improvements, social environment and education have an impact on the development of productive society.

When DeCarlo (McIrvine, <u>et</u>. <u>al</u>., 1967) summarized the consequences of productive society, he included the following:

1. Technical accomplishment changes the environment of our value systems.

2. Increased productivity and the changing nature of work.

3. There is increased "depersonalization" of life and a mismatch between human and machine factors.

4. The increased concept of the scientific and technical community which operates in an influence of educational environment.

A review of literature revealed certain predominant influences that had an effect on the development of productive society. Some of these concepts include economic structure, production systems, socialization, industrial organization, scientific developments and many more. One point, however, is clear: human endeavor is a part of each influence.

Purpose of the Study

The purpose of the present study was to determine how industrial arts teachers in the Province of Alberta interpreted the concept of productive society. The purpose in turn gave rise to the following sub-problems:

1. A compilation of the characteristics of productive society as based on a review of literature.

2. A description of each characteristic to show development during certain significant ages in an attempt to illustrate present day productive society.

3. The construction of an instrument to determine the interpretation of these characteristics by the industrial arts teachers. This instrument was based upon items (1) and (2) above.

Need for the Study

Since the industrial arts program has changed, some uncertainty has become evident with respect to curriculum content on the part of the teachers. Kauffman (1964, p. 29) once noted:

> The unaggressive position of industrial arts is particularly unfortunate for of all the subjects of the curriculum it should be most sensitive to many of the new impacts. The gigantic technological explosion of the mid twentieth century can possibly be better explained in the department of industrial arts . . .

The uncertainty seems to be perpetuated by a lack of a thorough understanding of the implications of the modern technological progress. Taba (1962, p. 3) stated:

> The strongest pressure for re-examination of the curriculum comes from the drastic changes in technology and culture, ranging from automation to atomic power, the voracious demands of the expanding industry on intelligent man power, and, in the words of the Rockefeller Report, "the constant pressure of an even more complex society against the total creative capacity of its people."

According to Hostetler (1962) progress becomes a key point for curriculum content and re-evaluation. Improvement through refining the content and organization is limited; desirable improvements will call for new departures or "sweeping changes" such as those made in the modern-day sciences. Evans (1962) also noted that physical sciences have made changes and improvements where there is a concentration on current issues, interests and problems, rather

than on history for the sake of history.

The need for prompt, constant re-examination about which Taba was concerned and the need for improvements with concentration on current issues become important in present-day productive society. It should be clear that Albertans are living in such an age.

It then becomes evident that industrial arts teachers of Alberta should be constantly aware of their subject matter in an attempt to keep a parallel with changes in a productive society. In order to determine and evaluate the adequacy of the curriculum content and the pursuit of the objectives of awareness of productive society, one must measure the understanding and assessment of productive society by the teachers.

To achieve this objective, the characteristics of productive society were defined and a criterion based on these characteristics was established. The organization of the characteristics could assist the teachers in formulating their own concepts and organizing their knowledge of industrialism and social function.

In summary, change is a force that cannot be overlooked. Changes in industry have a bearing upon industrial arts, and teachers must be cognizant of these changes if they are to improve the industrial arts program. The awareness of society and the knowledge of its function could affect the methods of instruction. Eddy (1962,

p. 11) pointed out:

> One of the greatest problems in the 1960's will be the upgrading of many of our older instructors who have been accustomed to teaching basic courses in accordance with out-of-date analysis and objectives. In addition much of the equipment in our older shops is obsolete and the manipulative skill mastered on such machines has very little value in industry today.

Method

The study was essentially done in two sections. Section one or Chapter II sets forth the characteristics of productive society. Section two outlines the procedure followed for establishing an instrument which was used to determine how teachers interpret the concept of productive society.

Section One

The concept of productive society encompasses a variety of different ideas. For the purposes of this study, the concept was organized into certain identifiable characteristics that were isolated and extracted from the literature. These characteristics, within a specific period of time, constituted the explanation of productive society. A review of literature from the disciplines of sociology, psychology, education, history and the sciences was conducted in an attempt to ascertain the characteristics that describe productive society.

Definitions

A characteristic, for the purposes of this study,

refers to the entities that are a part of industrialism. These characteristics represent the most significant influences that constitute an industrial setting which constitutes productive society. Some examples of characteristics are labor, management and personnel, control systems, planning and design, natural resources and others. Each characteristic is described in specific periods of time. Figure 1 shows the procedure for description.

Industrialism refers to social and economic organization as characterized by large industries or large industrial nations. Some elements included are organization, modernization, machine production and a new concept of mass society. Economic development is most important: the ultimate success of a nation depends upon the strength of industrialism. Productive society encompasses not only industrialism but also the educative and social organization for which industrialism functions. Industrialism, for the purpose of this study, is a part of productive society.

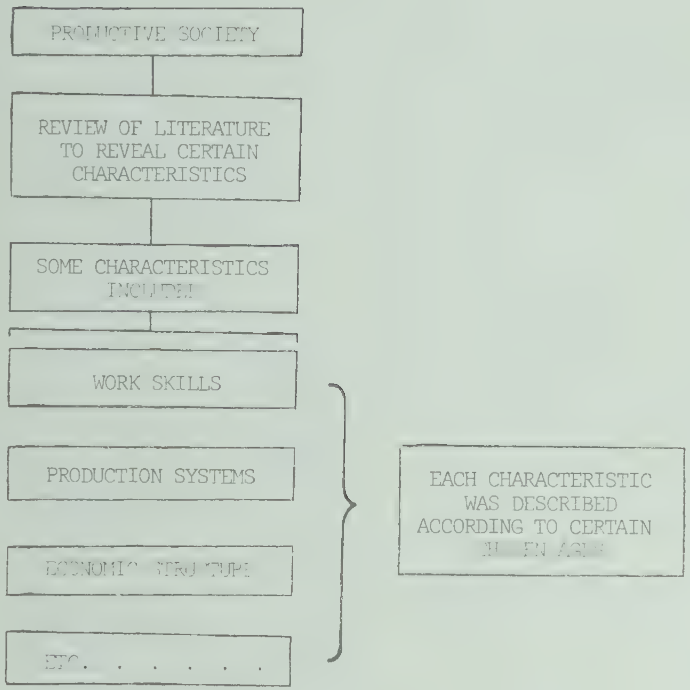
The procedure for description of the characteristics was done as follows:

1. Review of the literature to reveal certain characteristics.

2. A listing of the characteristics to describe productive society.

3. A description of each characteristic through certain dominant ages of productive society. These ages included:

   a. modern craft age.



CHARACTERISTICS	DOMINANT AGES OF SOCIETY				
	MODERN CRAFT AGE 1400	MACHINE AGE 1765	POWER AGE [illegible]	ATOMIC AGE 1953	CYBERNETICS AGE 1964
WORK SKILLS	All around skilled craftsman, unskilled manual laborer.	Machine replaces craftsman, need for technically skilled personnel	Skilled inspector and mechanic, mechanical operations replace need for machine feeding or tending.	Engineers, designers, skilled technicians.	Highly skilled technicians for increased maintenance and computer programming.
PRODUCTION SYSTEM	One man or family owned system. Use of simple hand tools.	No evidence of quality production, [illegible] tools, manual control.	Transfer machines, material handling, mass production.	Mass production, automation, standardization.	Quality control, computer controlled production lines, systems organization, data storage.
		FACTORY			
ETC.					
Inherent in this description will be concepts of technology, work, productivity, and the industrial scene.					

NOTE: The reader should keep in mind that each descriptive cell illustrates a different form of the particular characteristic involved. For example: The characteristic of work skills has been described in the modern craft age as consisting of the skilled craftsman and the unskilled manual laborer. This differs from the atomic age where engineers, designers, and skilled technicians possessed a different kind of work skill which was somewhat more sophisticated. It should be understood that some manual tasks are still used today and that workers still possess skills, but that these skills take on a different form. No attempt has been made to show a relationship between the descriptive cells. This is more fully described in Chapter II.

FIGURE 1

PROCEDURE FOR DESCRIPTION OF EACH CHARACTERISTIC OF PRODUCTIVE SOCIETY

b. machine age.
c. power age.
d. atomic age.
e. cybernetics age.

Figure 1 illustrates the graphical representation of the procedure used to describe each characteristic.

Section Two

Section two or Chapter III outlines the procedure followed for establishing an instrument for measurement.

Chapter II

The Concept of Productive Society

Introduction

When dealing with the concept of productive society, there are certain basic factors which are inherent in every aspect that is studied about productive society. Professional writing, if this may be used as a valid indicator, shows that the basic factors which are common to all aspects of productive society are:

1. The work function.
2. The industrial scene.
3. Significance of productivity.
4. Technology.

It is believed that a significant contribution can be made to a greater understanding of the different characteristics[1] which define productive society if one has a clear understanding of what each topic entails and its function within productive society as a whole. In other words, each of the four basic factors listed are a part of each characteristic, regardless of the characteristic or the time period in which it is described.

The Work Function

Max Weber (Bendix, 1960, p. 73) once noted:

---

[1] A definition of the term characteristic and the method used to describe the characteristics was shown in Chapter I.

> A man should work well in his gainfull occupation, not merely because he had to but because he wanted to; it was a sign of his virtue and a source of personal satisfaction. It is an obligation which the individual is supposed to feel and does feel toward the content of his occupational activity no matter in what it consists.

Work, according to the Protestant Ethic, was the most valuable and most important function of man. Karl Marx (1893) also noted that the key factor to understanding capitalist production was understanding the value of labor and its impact upon the economy of a nation. Labor power and the expansion of labor's productivity has had a significant impact upon world economic advancement and development. Tilgher (Nosow and Form, 1962, p. 25) stated:

> Both in production and in distribution today the modern American is an employee, whether managerial, white collar or blue collar, of a large corporation. Business is corporate business, both in the substantially correct modern public image and in its function of setting prices, policies and employment conditions.

Although the Protestant Ethic was at one time the central belief in the work function, Vincent and Mayers (1959) and Dunwiddie (Jehring, 1966) believe that there are at least seven basic reasons why individuals work. Each point is related in some way to work itself.

1. Individuals gain a sense of achievement from their work.

2. The need to share thoughts and feelings with others.

3. Desire to interact and relate to other individuals in the work situation.

4. The need for dominance over persons and elements in one's environment.

5. The intense desire for monetary funds which has no relation to the work or the other individuals on the job.

6. The need for self-determination and self-satisfaction.

7. The need for expressing ideas and solving practical problems.

The Industrial Scene

The *Encyclopaedia Britannica* (1963) noted that industry is the act of steady application of work or employment in a productive fashion for the manufacture of goods which in itself forms a trade or some form of manufacturing process. Moore (1963, p. 4) pointed out:

> Industry refers to the fabrication of raw materials into intermediate components or finished products by primarily mechanical means dependent on inanimate sources of power.

Moore (1965) noted four points that industrialization contributes:

1. Industrial systems provide the means to attain the desired goals and changes.

2. A certain degree of uniformity to social systems is provided.

3. Conditions for sequential patterns of change are initiated by industry.

4. Industrialization is the major and essential ingredient for economic growth.

A review of literature reveals that industry functions to satisfy human needs. The satisfaction of these needs constitutes the most significant position of the industrial

scene. The _Encyclopaedia Americana_, Canadian Edition (1963) and Nance (1959) indicated that the concept of utility is that power which is able to satisfy human needs. Production of goods involves the creation of utilities. With proper functioning of the industrial scene there is an efficient combination of productive factors for maximizing the creation of types of utilities. The five types of utilities are as follows:

1. Form utility--changing the form of material.
2. Place utility--changing the place or position of goods in relation to space.
3. Time utility--changing the availability of goods.
4. Possession utility--changing ownership.
5. Service utility--maintenance and service of goods.

The four main recognized factors that essentially contribute to utility are natural resources, labor, capital, and enterprise.

Significance of Productivity

Chwalek (Jehring, 1966) and Stokes (1968) stated that productivity is the ratio of inputs to outputs:

$$\text{PRODUCTIVITY} = \frac{\text{OUTPUT}}{\text{INPUT}}$$

It is concerned with the relationship between input of labor, capital and equipment and the output in terms of units produced or processed and the return on capital. Total productivity is the ratio used to determine how effectively the

tangible factors are being used to produce output. Chwalek (Jehring, 1968), Vance (1961), Slater (1966) and Kendrick (1961) reported that the term productivity is often used to express a measure of the relative measure of an industry's efficiency. Production and productivity are synonymous terms that represent the efficiency with which the process of converting tangible and intangible inputs into outputs of goods and services is done. Higher productivity indicates a better level of economic stability and national strength. Adam Smith (1937, p. 326) gave a good example of the role of productivity in the national economic growth when he wrote:

> The annual produce of the land and labour of any nation can be increased in its value by no other means, but by increasing either the number of its productive labourers, or the productive powers of those labourers who had before been employed . . . in consequences either of some addition and improvement to those machines and instruments which facilitate and abridge labour; or of a more proper division of employment.

The significance of productivity can be clearly seen when one realizes that productivity, according to Burck (1968), in the United States in the last twenty years has increased by as much as the entire Soviet Union annual production. Between 1850 and 1889 the annual increase average was about 1.5 percent, during the beginnings of industrialization. Between 1889 and 1919, there was a 1.6 percent increase in productivity growth. Between the two world wars an increase of 2.1 percent and 3.2 percent since the second world war were noted. Burck also noted that the goods produced were by

large corporations but services tended to be provided by companies that were small and owner operated. The service economy is likely to take over or overshadow the large corporations. Some of these services would include hospitals, universities, governments, research and professional organizations.

Technology

D. G. Moore (Ziel, 1964, p. 85) noted that, "The ultimate purpose of the productive society is human welfare." The development of productive society was spurred on by the development of industrialism and technology, with technology being the most important force in the application of science and knowledge to productivity and economic progress. In her development of technological progress, Hilton (1966) indicated that technology began with an enormous idea and the idea was put into reality by the use of mechanical aids. In other words, through the use of science and knowledge technology searches for labor-saving devices. Ideas become the basis for all technological development.

Buchanan (1965), Walker (1968), and Morse and Warner (1966) suggested that there are six main aspects of technology which are important toward understanding society and productivity. These are:

1. Biological technology--involves the psychological, genetics, organ transplants, and social environment.

2. Social engineering--deals with the social impact of technology.

3. Harnessing of power stored in the natural resources.

4. Development of new processes--deals with materials and production techniques.

5. Construction of machinery and tools--control of machinery and tools.

6. Cybernation--application of automation to material process.

Galbraith (1967) and Morris (1967) noted that the impact of technology upon productive society produces some significant consequences. They noted that technology:

1. Increases productivity.

2. Increases the need for greater capital requirements.

3. Provides new sources of raw materials.

4. Makes savings possible by cost reduction.

5. Requires specialized manpower.

6. Stimulates demand and new investment.

7. Produces specialization.

8. Affects human dignity in various ways.

9. Creates a need for efficient organization.

10. Acts as a balancing factor between capital and labor.

John Diebold (1964, p. 26) noted:

> As important as technological change is, we must recognize that technology is merely an agent for social change. Social change will in turn result in more profound consequences for business than the technological change which spawned it. . . . Management must look to social change as an active agent in business planning. . . . Key to social burden of change is education.

In summary, four basic factors influence each characteristic of productive society, regardless of the characteristic or the time period in which it was described. The four factors described were:

1. Work function.
2. The industrial scene.
3. Significance of productivity.
4. Technology.

It should be remembered that these factors will not be described again and should be kept in mind when considering each characteristic.

The Characteristics of Productive Society

An extensive review of literature has shown that productive society encompasses certain significant characteristics that are a part of productivity, industrialization and society as a whole. Productive society is dependent upon industry for its survival and existence--industry must be organized to meet man's desires and needs efficiently and effectively. The consensus of the authors reviewed and the frequency of topics discussed by them suggested that in their opinion the following characteristics accurately describe productive society.

1. Power and energy.
2. Natural resources.
3. Tools.
4. Materials.
5. Work skills.
6. Inventions and developments.

7. Scientific developments--biology, physics, chemistry.
8. Production systems.
9. Processes.
10. Transportation.
11. Communication information.
12. Labor.
13. Management and personnel.
14. Economic structure.
15. Industrial organization.
16. Marketing.
17. Planning and control.
18. Training and education.
19. Occupations.
20. Services.
21. Consumer products.
22. Environment.
23. Socialization.

These characteristics were considered to be descriptive of productive society for the purposes of this study. In order to illustrate and clearly describe each characteristic, time periods or ages were used when significant technological development took place. The five ages or time periods of modern industrial society are:

1. Modern craft age 1400-1800
2. Machine age 1785-1880

3. Power age 1870-1950

4. Atomic age 1950-1965

5. Cybernetics age 1964-Present

The dates roughly indicate the significance of these ages. Overlap shows that it is virtually impossible to show discrete chronological development.

Lewis Mumford (1934) described a three-stage evolution of technology which he labelled as eotechnic, paleotechnic, and neotechnic.[8] The derivation of the five ages was based upon this type of classification and a review of other literature. A brief description of each age follows:

The modern craft age began in the fifteenth century with the advent of modern civilization. New trade routes were opened, skilled craftsmen flourished and the use of considerable unskilled labor was required to perform the physical tasks which supported some form of productivity.

The machine age was heralded by the invention of the steam engine and its application to the textile industry in 1785. Steam power predominated the manufacturing industries and made possible the beginnings of production.

---

[8]Mumford uses three stages or time periods to describe civilization and technology as it occurred in the early years. The terms are only indications of time where certain significant technological developments occurred. Miller (Allen, et. al., 1957) also devised a method where he described certain concepts in a certain period of time. This study was based upon these structures and a review of other literature to attempt to arrive at a total description or structure of productive society. This structure is illustrated in Appendix D.

The power age was characterized by the widespread use of electricity. The year 1870 saw the production of the first practical generators for industrial and domestic use. Electrical energy made possible the development of automatic and transfer machines that revolutionized the industries. Toward the end of the power age, automation became the symbol of modern industrial society.

The atomic age was characterized by the development of nuclear power as a significant source of energy which will likely last for generations to come. Automation was more sophisticated and the development of the computer added to the already complex technological society.

The cybernetics age resulted when cybernated systems were introduced to perform work with such rapidity and precision that was impractical and impossible for humans to duplicate. Cybernetics was the control of the work function which relied upon the use of computers.

Technological developments before the modern craft age were not considered for this study because of the voluminous content and because no useful purpose would be achieved by examining these developments. Only the factors that had significance for description of an industrial society have been considered. No attempt was made to present an exhaustive review of concepts that were involved with the description of each characteristic. Only the significant points were used to show the descriptions.

The Description of Each Characteristic of Productive Society

In this section, each of the 23 previously mentioned characteristics are described according to the five ages outlined.

Power and Energy

Modern craft age. The development of power and energy was in very simple stages and crudely organized. Miller (Allen, et. al., 1957), Rae (Kranzberg and Pursell, 1967, Vol. I) and Mumford (1934) described power in terms of muscle, wind and water. The muscle of animals, particularly horses and mules, and the muscle of humans were the most common sources of power used. Much unskilled labor was used to perform lifting, hauling, storing and any other operations required to move goods from one place to another. Toward the middle and latter part of this age the water turbine was invented and employed to ease man's work. Water wheels were built for raising water from one level to another. The windmill was built and used as the chief power source for pumping water for land reclamation. The height of wind and water power use was toward the end of the modern craft age.

Machine age. This age resulted with the industrial revolution and the introduction of the steam engine as the prime source of power. Miller (Allen, et. al., 1957), Rae (Kranzberg and Pursell, 1967, Vol. I) and Ashton (1964) illustrated the use of the steam engine as most important

of the developments of the machine age. Human muscle power still had to be employed, but more work could be accomplished with the use of the steam engine. The reciprocating steam engine was first applied to the textile industry to drive spinning machines. Line and shaft transmission was important to facilitate the transmission of the newly developed power. Toward the end of the machine age coal was discovered and it had an impact upon fuel supply. Steam engines were improved and enlarged to develop more power. This age also saw the use of compound engines, internal combustion engines and the application of thermodynamics.

Power age. According to Miller (Allen, et. al., 1957), Rae (Kranzberg and Pursell, 1967, Vol. I), Mumford (1934) and Oliver (1956), the power age was characterized by the widespread use of electricity. Electrical energy was possible through the expansion of energy exploration and the wide use of coal as a source of fuel. Electricity soon replaced the overhead lines and shafts that were characteristic of the steam engine era. The manufacture of generators was common and the use of electric motors spelled efficiency and effective production methods. During the latter stages of the power age the internal combustion engine provided means of portable power which began to revolutionize the transportation industry. The use of coal gas for lighting and heating was being developed for industrial use.

Atomic age. Energy is the basic tool of progress. Everything around us consists of what nature has provided and of man's work, which is spent energy. Fairchild and Landman (1961) noted that the first great changes came with the advent of the Industrial Age based on engines that used energy stored in coal beds which resulted in the spread of industrialism throughout the country. Since this time, energy from petroleum and other sources has caused change to come more swiftly. Miller (Allen, et. al., 1957, p. 260) stated:

> . . . to the best of our knowledge, there are three fundamentally different kinds of natural forces. These are gravitational forces, chemical or electromagnetic forces and nuclear forces.

Miller noted that nuclear force is the most powerful force yet known to man. Research has shown that the release of atomic energy will eventually bring out an increase in the available energy supplies. Miller (Allen, et. al., 1957), Fairchild and Landman (1961) and Klemm (1964) noted that the development of atomic energy for peaceful uses has been man's greatest invention and discovery. For many decades to come there will be an unlimited supply of energy to not only maintain but to also accelerate the present form of industrialism. Atomic energy became the single most important characteristic of the atomic age. Conventional sources of energy are dwindling in the world and atomic energy will alleviate the shortage. Klemm (1964), Miller (Allen, et. al.,

1957) and Buchanan (1965) reported that man's successful transition into the atomic age was ushered in during the year 1945 by the detonation of the first atomic bomb. Peaceful use of atomic energy was displayed in 1953 with the announcement by the Atomic Energy Commission of its decision to build a commercialized atomic energy electrical plant.

The successful "breeding" of fissionable material was closely studied by private and government agencies. The National Planning Association (NPA) reported in 1957 a simple definition of nuclear energy:

> As a simple working concept "nuclear energy" has been defined as the products of controlled nuclear reaction of fissionable material derived from natural uranium or thorium.

The NPA listed three distinct products of sustained nuclear reaction:

1. Radiation--radiant energy from the process of fission.

2. Heat--for process heat applications and to generate steam to produce electrical power.

3. Neutrons--for the production of radioactive isotopes and additional fissionable material.

The NPA (1957) and Lansdell (1958) concluded that special factors have arisen as the result of atomic energy development. Some of the more significant factors include:

1. Availability of new constructional materials and methods of fabrication and processing.

2. Atomic power reduction of fuel consumption, thereby having an influence upon the economic aspect of energy conservation.

3. The science of nuclear developments, which cannot be contained, and the theories, which are obtainable to anyone in the world, producing the hazards of radiation exposure.

4. Questions of military security and international safe keeping.

Lansdell also noted that atomic energy research has influenced the development of industrial techniques in three general directions.

1. By evolving a new flotation and ion exchange process for ore concentrations and powder metallurgy.

2. By producing new alloys with high heat and corrosion resistance.

3. By producing process by-products of commercial value for development of plastics, oils and paints.

Atomic energy is different from present fuels in three different ways. The potential energy is thousands of times greater than that of conventional fuel, production of nuclear energy is self-reproducing and the amount of recoverable natural uranium is far greater than that of fossil fuels.

The most common and immediate use of atomic energy was in the production of electrical power for industrial and domestic consumption. Miller (Allen, et. al., 1957) stated that the nuclear reactor can change ordinary uranium into fissionable plutonium at a rate equal to the rate at which U-235 is being consumed. The reactor becomes a combination power station and fuel factory. The heat produced can be used to heat a liquid which will raise steam to drive

a turbine-generator combination. It is known that the burning or consumption of one pound of fissionable material produces energy which is equivalent to 1500 tons of coal. By burning ten pounds of fissionable material a day, a reactor can produce electrical capacity equal to that of the Hoover Dam. Oliver (1956) reported the application of radioisotope devices for detection purposes, for treatment of cancer in the field of medicine, and for the development of further techniques of research into the science of chemistry and physics. The peacetime use of atomic energy pointed the way to the highest standard of living ever enjoyed by the human race.

Cybernetics age. Energy resources today are well developed and further research and development has uncovered more efficient ways of dealing with petroleum, coal and the applications of the internal combustion engine, gas turbines and more efficient and diverse uses of electrical energy. Duffie (Kranzberg and Pursell, 1967, Vol. II) noted that energy resources today are a "matter of serious concern." The seriousness of the matter is described in three ways:

1. The availability of energy resources is variable with time. The danger of depletion of coal, oil and natural gas reserves serves as a threat to modern productive society.

2. The population is increasing and as health measures are improved the life span of individuals increases, making extra demands for energy.

3. With the advent of technological change, the

per capita demand for energy is rapidly increasing.

Oliver (1956) and Duffie (Kranzberg and Pursell, 1967, Vol. II) described new developments that are making significant contributions to the energy pool that already exists. Increased exploration is taking place to uncover new and deeper petroleum deposits. Conservation has become an important consequent as a result of the danger of energy depletion. Energy development becomes more costly as the oil wells get deeper, and coal reserves become thinner. Natural gas has become a significant source of energy for both domestic and industrial markets. Shale oil and tar sands are becoming important sources of petroleum and the production of natural gas is even more critical as the demand for energy increases. Some of the most significant developments that have taken place in the cybernetics age are listed as follows. (Some are only in the stages of research and development but show promise as sources of power and energy.)

1. Increased use of water power in the form of hydroelectric stations.

2. Research into tidal power for electrical generation.

3. Investigation of wind power. Several experimental plants of large capacity have been built and operated.

4. Solar energy for the charging of storage cells.

5. Biological energy as a prospect for food production and chemicals by the process of photosynthesis.

6. Nuclear energy expansion in use, which will easily make it the most common source of energy and power.

The immediate future does not see a shortage of energy resources, but development and conservation must be enforced for a long range of plans. Figure 2 illustrates man's mastery and control over energy in the cybernetics age.[9]

---

[9]It should be noted that the descriptions of power and energy in the various ages involves certain basic and in some cases common concepts. For example, the modern craft age used the power of muscle, wind and water. The machine age was characterized by the power of steam. The power age used the power and energy of electricity and coal extensively for industrial production purposes. The use of uranium and petroleum were important in the atomic age. The cybernetics age saw the use of natural gas, and further applications of petroleum. Conservation was important for the preservation of the resources for power and energy production.

It should be kept in mind that in present-day productive society or the cybernetics age some muscle power is still used, but on a very limited basis. Power and energy are still derived from steam, electricity, coal, petroleum, uranium and natural gas. The descriptions for each age indicate only the significant concepts for the particular age. The descriptions of technology in the earlier years still serve as a basis for many of the activities of present-day productive society. Today's activities in industry are somewhat different but remain in a similar form; for example, cutting tools used in the modern craft age were employed to cut material away until it was properly shaped. The cybernetics age still uses cutting tools and the basic operations of cutting are still the same, but the tools are more sophisticated and the speed and precision of cutting are more accurate. No attempt has been made to show development of each characteristic throughout the ages. Only descriptions of the most significant concepts for each characteristic are shown in each particular age. It should be kept in mind that some of the concepts for each characteristic are similar for each age and many of the activities that were employed in the earlier ages are still used today, but in a somewhat refined and more precise manner.

Areas of Advance	Some Typical Means	Some Results
Far greater magnitudes & intensities of power available	H-bombs, nuclear reactors & nuclear dynamite, chemical fuels for rockets	Major change in methods of warfare, national defense, strategy & tactics, & international politics New scientific knowledge New power-plant fuels Thousands of new technical needs Possibilities for major alteration of geographic features
Energy handled in more minute quantities, & controlled with increased precision	Semiconductors, lasers, micro-electronics	Thousands of new components, products, & processes New instrumentation Many new demands for scientific & technical knowledge Reduction in size of many devices Production processes based on high-energy forming, spark erosion, electrodeposition & polishing, ultrasonics, & so on
Power generated & transformed by new sources & devices	Nuclear reactors, fuel cells, solar cells, magnetohydrodynamics, thermoionics, jet engines, stationary power plants	Continuing pressure for advances in fuels, materials, & controls Need for scientific knowledge & technical development
Significant advances in energy storage	Atomic fuel, fuel cells, nickel-cadmium batteries, pump-hydro power, & tidal power	Increased portability Longer operation between refuelings Lower power costs
New techniques for large-scale transportation of energy & fuels	Extra-high voltage transmission lines, liquid propane gas ships, oil, gas, & coal pipelines, unit trains, & cross-country conveyor belts	Cheaper movement of many fuels Transportation of energy & fuels feasible over greater distances Specialized construction & transportation equipment

FIGURE 2

INCREASED MASTERY OF ENERGY

NOTE: This figure appears in Bright, J. R. Opportunity and threat in technological change. Harvard Business Review, 1963, 41, 79.

Natural Resources

Modern craft age. Although the natural resources, as we know them today, existed in the modern craft age, there was little use of some of the basic resources. L. A. Wilkie and Kranzberg and Pursell (1967, Vol. I) noted that the basic natural resources are:

1. Water.
2. Metals.
3. Minerals.
4. Forests.
5. Petroleum.
6. Fertile soil.

Rosenberg (Kranzberg and Pursell, 1967, Vol. I), Forbes (Kranzberg and Pursell, 1967, Vol. I) and Kranzberg (1967, Vol. I) noted that the natural resources in the modern craft age were not well developed and included simple mining and extensive agricultural activities. The society during this age was predominantly agricultural and the land resources were being extensively utilized. Wood was used for structural and fuel purposes with no development of lumbering techniques. There was no exploitation of minerals and water was simply used to develop small sources of power.

Machine age. The machine age saw mining become more diversified, and iron and coal were the most significant natural resources. Iron and coal signaled the rise of productivity and a revolution in the manufacturing industry. Oliver (1956) and Fussell (Kranzberg and Pursell, 1967, Vol. I) stated that the agricultural revolution was signaled in the machine age. The revolution consisted of three factors:

1. Improvement of implement design and invention of new machines.

2. The improvement of livestock and breeding aspects.

3. The introduction of new crops to open fields.

The machine age also introduced the concept of alloying and steel formation. Copper appeared as a non-ferrous metal.

Power age. Oliver (1957) and Kranzberg (1967, Vol. I) suggested that no real significant change in the use of natural resources occurred. There was greater development of processing techniques and methods that made the exploitation of natural resources more prominent. Toward the end of the power age the concept of conservation was employed.

Atomic and cybernetics ages. These two ages were combined because no differentiation between them occurs. The development of natural resources can be revolutionized, and the techniques improved for extraction of the minerals from the earth's crust.

Oliver (1957) and Penick (Kranzberg and Pursell, 1967, Vol. II) noted that in the early 1900's it was evident that the demands on the North American natural resources were exorbitant and conservation-minded people became alarmed. Many industrialists were disturbed over the amount of waste and exploitation of the abundance that once existed. Surveys were undertaken to determine the amount of coal and iron deposits, natural gas and petroleum supplies that existed, and it was thought that many of these resources

would not last another hundred years. Surveys also showed that forests were being slashed and tons of top soil were being washed away. It was also noted that there was a tremendous loss of resources through poor extraction and transportation techniques. Through government efforts a National Conservation Board of America was established at the First National Conservation Congress in 1908. Through the effort of government and other industrial conservationists certain consequences of conservation began to take shape:

1. Problems of irrigation, soil conservation and forest prevention were tackled immediately.

2. The population as well as industrialists were made aware of the fact that resources can be easily and quickly depleted.

3. A committee of scientists established rigid programs of conservation to be followed by governmental agencies and private corporations.

4. The forces of government, science, and industry were able to enforce the rigid standards of conservation. Proper instrumentation and methods were used and the nation was assured that plenty of resources would be available for generations to come.

5. Scientists sought salvage techniques.

6. Development of by-products, for example corn oil, was also used in the manufacture of vulcanized rubber.

7. Vast programs of reclamation were instigated in forestry, land management, mineral lands, and water and power.

Tools

Civilization has been built and developed with the aid of man's intelligence. Through the coordination of man's

brain, eye movements and muscle reflexes, he was able to utilize his hands and arms to manipulate objects. The earlier forms of objects were stone, which later gave way to combinations of wood, metal and stone. The objects were commonly noted as tools. Leighton A. Wilkie described nine different operations that man has developed through the use of tools. These operations included:

1. Measuring.
2. Holding.
3. Slicing.
4. Drilling.
5. Burnishing.
6. Boring.
7. Scraping.
8. Chopping.
9. Sawing.

Many crude forms of tools have been developed and invented since about fifty thousand years ago. Mumford (1934) and Walker (1968) described tools and machines as interchangeable concepts. Tools were developed from simple hand operations and became more specialized as technology significantly influenced the world of invention. Mumford (1934, p. 10) noted:

> The essential distinction between a machine and a tool lies in the degree of independence in the operation from the skill and motive power of the operator: the tool lends itself to manipulation, the machine to automatic action.

It was noted that specialization function was also characteristic of machine performance. For the purposes of this study, the terms machines and tools are used interchangeably. The concept of mechanization is used occasionally and is dealt with more fully under the heading of production systems.

Modern craft age. This age witnessed the use of simple hand tools that were made from wood and some sort of metal. Mumford (1934), Bredenbaugh (1950), Laird and Laird (1964), Oliver (1956), Walker (1968) and Klemm (1964) described the basic tools as crude but functional for the purposes designed. Some of the tools that the craftsmen possessed included:

1. Simple knives and skewes.
2. Hand twist drills.
3. Early forms of boring tools.
4. Plow planes.
5. Gouges.
6. Simple saws.
7. Files and forge tongs.
8. Crude forms of measuring instruments.

These tools were constructed from wood and some crude forms of iron, and in some instances bronze was employed. Some of the most common tools and implements were used for agricultural purposes. Certain implements included:

1. Plough shares.

2. Iron teeth and harrow frames.

3. Scythes.

4. Reaping hooks.

5. Steeled axes.

6. Spades, hoes, shovels, iron rakes.

Machine age. This age represented the most significant period in history of machine and tool invention. The industrial revolution characterized the development of the wheel, axle and shaft, which were used for the transmission of power output. This significant development had a tremendous impact upon industrialization and the development of increased productivity. Mumford (1934, p. 47) noted: "To fix attention upon a mechanical system was the first step toward creating a system." The beginning of systems and systems ideas was incorporated into the practice of industrial techniques and specialized production systems.

Power age. The power age was noted for its use of various automated forms of tools. The basic process of cutting that was mentioned earlier was still incorporated, but in a different form. The power age was noted for the inclusion of precision, more automation, speed, quality, control and the use of more complex machines. The most significant developments were:

1.	The screw cutting lathe	1800
2.	The drill press	1840
3.	The boring mill	1775

4. The planer 1817

5. The milling machine 1818

6. The band saw 1933

7. The grinder 1880

These machine tools constituted the basic tools of industry. The tool-making industry was in itself a significant factor in the spread and modernization of industrial society. The growth of size of markets for machine tools and the improvement of technical skills and knowledge created an industry of product specialization.

Atomic age. This age was noted for the concept of automation and automatic controls of machines and machine tool processes. Woodbury (Kranzberg and Pursell, 1967, Vol. I) noted that there was a greater refinement of the wheel-shaft principle. A larger range of gears, pulleys, shafts, and improved methods of tool making enlarged the range of tools and produced even more new production systems. The improvement of holding devices resulted in precision and speed in production with machine tools. Some of the devices included universal lathe chuck, tool post and holder, drill chuck, indexing vise, and magnetic chuck. Gauge blocks and micrometers were the basis of measuring instruments. Precision and interchangeability of parts and the manufacture of interchangeable parts were the significant results of tool and machine tool development.

Cybernetics age. The cybernetics age was noted for

the introduction of computer technology. Computers are, in a sense, a form of machine tool that has a wide application range from calculation and data processing to control of machine tools. Bright (Kranzberg and Pursell, 1967, Vol II), Wiener (1952) and Greene (1962) stated that the use of the computer and its application to machine tools and automatic transfer machines was the most significant development of this age. Numerical control, automation and computers were the key words of modern industrial society with respect to industrialization. Automatic manufacturing subsided somewhat, but progress continued. The more important technological developments were emphasized at the end of production in the form of storage, transportation and data processing, which were the areas of greatest attention. Figure 3 illustrates the development of machine tools and the impact upon man's material welfare.

Materials

Materials are closely related to natural resources. For the purposes of this study materials refers to manufactured goods or substances that are used for further manufacture. Plastic, for example, involves the use of certain natural resources such as coal and oil and other minerals. Once plastic has been formed, it is used for the making of parts and as a basis for construction and manufacture of consumer goods.

Modern craft age. This age used simple natural

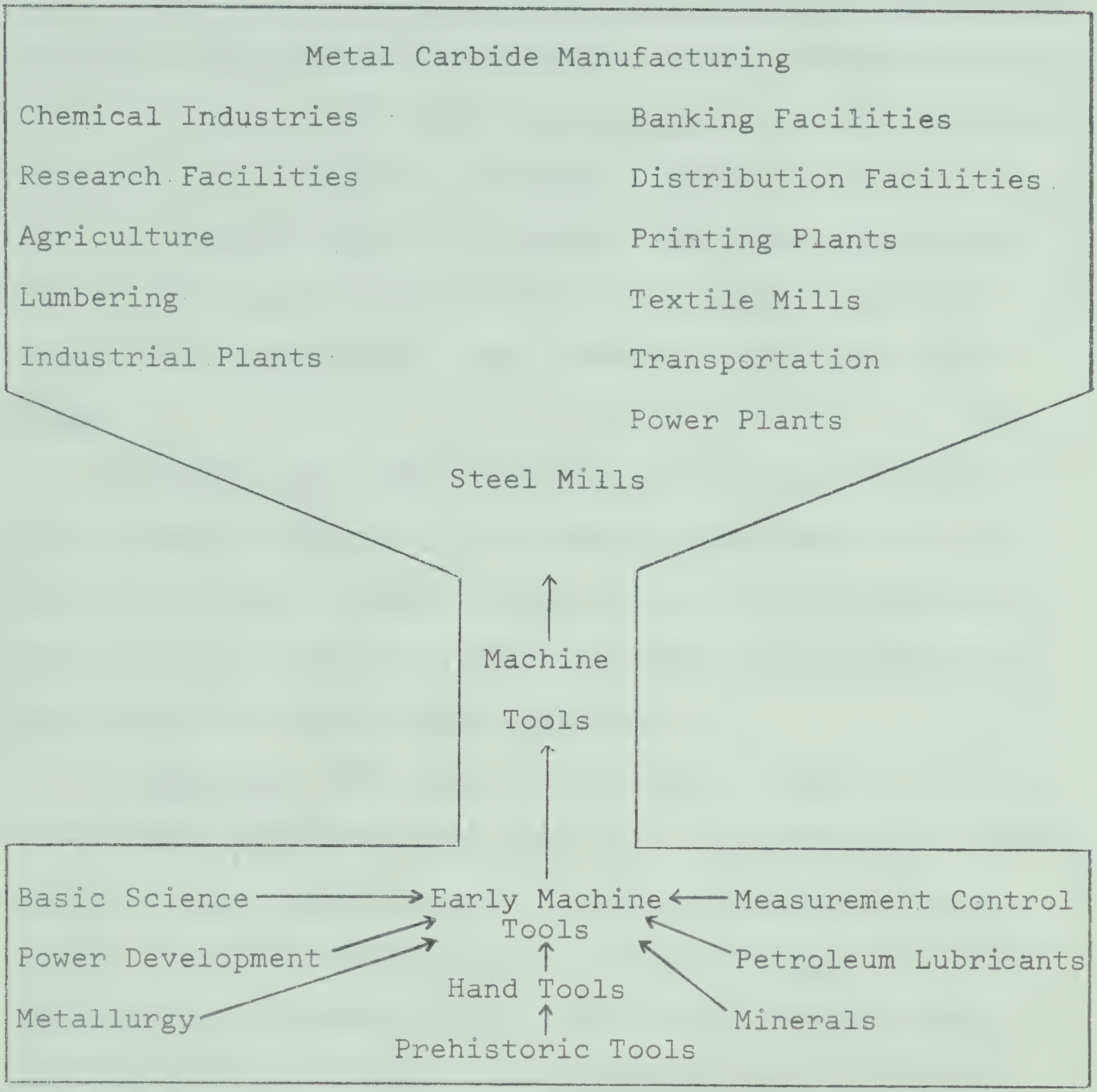


FIGURE 3

DEVELOPMENT OF MACHINE TOOLS AND THE IMPACT
UPON MAN'S MATERIAL WELFARE

NOTE: This diagram is adapted from Wilkie, L. A., <u>Civilization Through Tools</u>. Des Plaines, Illinois: Wilkie Brothers Foundation. Chart.

resources of wood, iron and bronze to manufacture goods and materials for domestic consumption. Olson (1957) and Miller (Allen, et. al., 1957) noted that, because of limited technological and scientific knowledge, products and materials were not numerous and were simple. The most common materials of this age included cotton, silk, wool, cloth and thread, some glass, cast iron, leather, paper, ink, and lumber.

Machine age. The machine age was characterized by the making of steel and the processing of copper from the earth's surface. Toward the end of the machine age malleable iron, charcoal, coke, natural cement and machine-made paper and cloth were common materials.

Power age. This age, according to Mumford (1934), Olson (1957), Miller (Allen, et. al., 1957) and Vance (1961), was noted most significantly for the production of metal alloys. Through the development of technology, aluminum was abundant and the production of hydroelectric power made possible the development of light-weight and yet strong alloys. The transportation industry was reliant on these alloys. Some other materials included increased use of steel, chemicals, celluloid, glass, silver, silicon, selenium, tungsten, manganese and chemicals for corrosion resistance. The power age saw the development of a range of synthetic compounds to replace some of the common elements of wood, paper and glass.

Atomic age. The atomic age utilized the new range of synthetic materials which included plastics, super alloys with extremely desirable strength and heat resistance characteristics. Titanium, zicronium, chromium, molybdeum and other exotic elements and materials were important toward the manufacture of tools and equipment. Product differentiation and characteristics of strength, heat resistance, insulation, resistivity to electricity and corrosion were the strong points of the atomic age.

Cybernetics age. According to Kendrick (1961), Greene (1962), Vance (1961), De Garmo (1957) and Bright (Kranzberg and Pursell, 1967, Vol. II), materials handling techniques, research, and development were the highlights of the cybernetics age. Technology was advanced far enough that the manufacture of large quantities of materials was possible at a low cost. It was essential that engineers and designers become familiar with the wide range of materials available before any planning and design could be completed. Manufacturing processes were very important as these would affect the characteristics of the new materials that were designed. Materials handling became important and accounted for fifteen to eighty-five percent of the cost of a product. Materials had to be dealt with in such a fashion as to:

1. Eliminate waste.
2. Make efficient arrangements and plans for processing.

3. Demand skilled and specialized labor.

4. Reduce the damage due to transportation procedures.

5. Substitute mechanical handling.

6. Demand efficient use of administration, communication and control.

Figure 4 illustrates some of the common materials that are used in the manufacture of pulp wood and paper. This isolated example is used to illustrate how materials are used and how this type of process is similar for other manufacturing as well.

Natural Materials	Processed Materials
Wood: Spruce Hemlock Pine Fir Poplar Hardwoods Lime Water	Salt cake Soda ash Caustic soda Sulphur Chlorine Rayon Plastics Color dyes Alum

FIGURE 4

COMMON MATERIALS USED FOR THE PRODUCTION OF PAPER

NOTE: This figure is a summary of a presentation which appears in Vance, S. Industrial Structure and Policy. Englewood Cliffs, New Jersey: Prentice-Hall, 1961, p. 356.

Figure 5 illustrates some of the most recent methods and consequences of materials science. Types of products have not been mentioned here and are dealt with under the heading of consumer products.

Areas of Advance	Some Typical Means	Some Results
New properties for old materials	Chemical & metallurgical knowledge applied to alter properties of materials	Improvement of properties such as strength, weight, heat resistance, & corrosion resistance
Synthetic materials	Better control of purity, additives, & processes New production processes	End-users require different production processes & work force skills
Combinations of materials to provide unique characteristics	Typical examples: aluminum engine blocks, paper & plastic replacement of textile cloth Synthetic fibers, rubber, oil, & food Fiberglas, prestressed concrete, ceramic-metallic compounds, laminated wood beams, & panels of aluminum-plastic honeycomb construction	Lower cost for many materials and/or end products

FIGURE 5

INCREASED ABILITY TO ALTER THE CHARACTERISTICS OF MATERIALS

Bright, J. R. Opportunity and threat in technological change. Harvard Business Review, 1963, 41, 81.

Work Skills

Work skills are closely related to labor and management. Certain skills are needed in the industrial world to perform the work function up to set standards. There will be no relation to management or the labor force here. These concepts are dealt with later.

Modern craft age. Mumford (1934) and Miller (Allen, et. al., 1957) indicated that the modern craft age possessed individuals who were usually all-round manually skilled craftsmen who performed work functions that were related to the manipulation of hand tools. Each craftsman performed all the work functions that were necessary to complete the product that was being made. There also existed a significant amount of unskilled manual labor which was required to do the lifting, hauling and storing that was required to move goods from one place to another. There was also the presence of much unskilled farm labor.

Machine age. The machine age changed the skilled craftsman to a semi-skilled machine operator. This age was noted for the competition between man and machine, for the machine was being made to perform functions that were ordinarily done by hand. The handicraft worker had been reduced into competition with industry and the machine consequence. The introduction of the factory system brought about the end of the crafts skills. The worker needed a new kind of skill, a skill to deal with and bargain with the employer for a fair

share of the profits that the industries were enjoying.

Power age. This age demanded new kinds of qualities and skills. These new qualities were alertness, responsiveness and an intelligent grasp of the mechanization that soon became common. The worker had to be an all-round mechanic rather than a specialized hand, as was evident in the modern craft age. The need for unskilled manual labor was reduced. New kinds of occupations, such as skilled machinists, technicians and inspectors, became the important concept of skill in industry. Automation changed the work scene.

Atomic age. The atomic age saw drastic change in the work function. Nosow and Form (1962), Goldberg (Hilton, 1966) and Greene (1962) noted that as automation increased there was increased displacement of both blue-collar and white-collar workers. There was increased emphasis on intelligence, and the ability to be able to respond quickly and efficiently was the prime requirement of workers in both categories. The demand for semi-skilled and unskilled workers such as farm laborers and industrial workers became very low. Every person who was to enter any type of job had to possess certain intellectual types of skills so that he could be trained quickly and efficiently on the job. Work content became an important aspect of productivity. Research was started into increasing the efficiency of each person involved.

Cybernetics age. This age was similar in that there was a greater need for workers to be able to cooperate and

interact with each other during the course of work. There was greater demand for highly skilled technicians for increased maintenance and computer operation and programming. The skill of manipulation of buttons and controls became the main type of activity. Some of the basic skills that were now needed included:

1. Effective contribution to the work function.
2. Management qualities.
3. Ability to make decisions.
4. Exercising of responsibility.

Inventions and Developments

It can be clearly established that a modern industrial society would not have evolved if certain scientific and technological inventions and developments had not occurred. Hilton (1966, p. 4) suggested:

> The most important step to any new development is always the idea. In the past there has been usually a long period during which man could learn to adjust to new ideas long before they could be implemented. Technological change was slow and more complex social changes could keep pace.

The whole history of invention began with an enormously imaginative idea. But Kranzberg and Pursell (1967, Vol. I) noted that it was not only the idea that was important but that invention was triggered by social needs, economic requirements and the level of technology at any one given time. Invention covers every aspect of human life and also depends upon the sociocultural and psychological circumstances of a society. Forbes (Kranzberg and Pursell, 1967,

Vol. I) noted that invention was governed by two elements. One was discovery and the other was a mental process that could refine the discovery and place it to practical application. Much experience was needed before truly significant developments or inventions were created. Rae (Kranzberg and Pursell, 1967, Vol. I) and Ogburn (Allen, et. al., 1957) noted that the invention of inanimate objects caused social change. Social change was possible because of the increased influence upon industrialization and upon the social system that functioned within an industrial society. Some of the direct effects of inventions and developments caused increased status and the use of labor-saving devices to free man from the drudgery of back-breaking work. The effect of invention was not curtailed, but caused other changes to take place. The effect of development seemed to be self-perpetuating. It became clear to Hart (Allen, et. al., 1957) that the concepts of invention and cultural change were closely interrelated. The speed of cultural change depended upon four basic factors:

1. Speed and completeness of inventions.
2. Amount of improvement of each development.
3. Degree to which scientific elements are applied.
4. Intensity of need to the solution of various problems.

The rate of diffusion of inventions has rapidly decreased, and today's developments take less time to be put

into practical use with much less experimenting and overall elapsed time. Some inventions and developments will be listed to show the growth of inventions and technological progress. No attempt was made at an exhaustive listing. Only certain significant concepts were introduced. The list was derived from Kranzberg and Pursell (1967, Vols. I and II), Mumford (1934) and Oliver (1956).

Modern craft age.

1430	Turret windmill
1530	Paddle wheel boats
1595	Design of metal bridges
1600	Water wheels of 20 horsepower
1610	Discovery of gasses
1619	Use of coke

Machine age. The machine age was characterized by the developments of mining and textile machinery. The foundation of modern chemistry was developed. Such inventions as the following were developed:

1. Iron casting.
2. Iron plow.
3. Engine applications.
4. Steam engine.
5. Factory and manufacturing.
6. Steel casting.
7. Iron wheels.
8. Cement.

Power age. This age was characterized by gains in power conversion and mass production of textiles, iron and steel machinery. This was the evolvement of the railway era and foundations of modern sociology and biology. Further developments included:

1. Voltaic cells.
2. Steam applications.
3. Steel alloys.
4. Steam automobile.
5. Water turbine.
6. New synthetic materials.
7. Agricultural machinery.
8. Some leisure items.

Atomic and cybernetics ages. These ages were characterized by the development of scientific and technical research laboratories. The professional scientist, researcher, and engineer became the inventors of these ages. New tools, machines, products and processes were the result of computer operations which developed new ideas with incredible speed. Some significant developments included:

1. Standardization of tools and production methods.
2. National Bureau of Standards.
3. Government-sponsored activities to improve inventions and developments.

Scientific Development

According to A. N. Whitehead (1953) science and scientific developments took over the ideas that persisted in men's minds. Science became the basis for future developments

of various fields and disciplines in the scientific world. Mathematics was closely related to the scientific world and had some direct bearing upon development. Adam Smith (1937) noted that science became the stepping stone for all technological developments. Before any person could become a professional or achieve any significant developments he had to possess a thorough knowledge of basic scientific principles.

Modern craft and machine ages. It was on this basis that science began to occupy a significant place in a modern industrial society. A review of literature shows that there was no clear definition of science and scientific principles in the earlier parts of civilization. In the modern craft age and the machine age it was noted that simple scientific principles were applied to development and invention. Some knowledge of science and mathematics was necessary before any significant inventions could be produced.

Power age. It was not until the power age that a clearer relationship between science and technology was established and was significant with respect to industrialism. Walker (1968) and Drucker (Kranzberg and Pursell, 1967, Vol. II) noted that technology was an "offspring" of science. It was not until the power age that scientists were interested in technological developments and the application of their discoveries. The most significant developments during this age were the development of synthetic

fertilizers, refrigerators and the extraction of protein for human use. The development of organic and inorganic chemistry and the electron theory were all science-based. Electrical engineering was important with men like Faraday, Henry, Bell, and Marconi. Generally, the relationship between science and technology did not have real significance until the nineteenth century. A. N. Whitehead (1953, p. 98) noted that "the greatest invention of the nineteenth century was the invention of invention." Whitehead also noted that methods of pure science and the mastery of science beyond technology signifies a change from an amateur to a professional.

Atomic and cybernetics ages. These ages saw the most significant application of science and technology to modern industrialism. Drucker (Kranzberg and Pursell, 1967, Vol. II), Schwartz (Hilton, 1966), Walker (1968), and Morris (1967) noted that the line between science and technology has become somewhat "blurred." Technological work, for the most part, is based upon scientific work. Much of the research that is accomplished is done in "pure science" concerned with theoretical knowledge. It is seldom the case where a research project starts a technological process without some scientific study. In many cases the scientist who finds new basic knowledge and the technologist who develops the new process are the same individual. The scientist, however, is usually found in the research lab and

has little to do with the design of mechanical equipment, machines and tools. The greatest amount of work on the development of new products comes after the scientific work has already been done. Science is a particularly efficient method for obtaining, applying and organizing new knowledge. The scientific method has become the best method for obtaining fuller intellectual understanding and increased practical control in all fields of endeavour. Technological change depends on the existence of science for the practical application of new principles. The "technological-scientific" revolution creates a greater need for a more precisely planned economy and the training of more adept leaders to guide the way for this type of revolution. Figure 6 shows some of the consequences of science and technology working together.

Production Systems

Some form of production systems have always existed with the simplest system originating in agriculture.

Modern craft age. A review of literature reveals that there were no significantly structured systems of production in the modern craft age. Usually one craftsman was the head of a family-owned system that had limited output with the use of simple hand tools.

Machine age. The machine age saw the structure of the factory system, which brought about a change in the levels of productivity. Oliver (1956), Hall (Kranzberg and Pursell,

Areas of Advance	Some Typical Means	Some Results
Direction of long, intricate machinery actions	Feedback control of process equipment Punched card control of bulk materials batching Numerically controlled machine tools Punched-tape control of typewriters, & so on	Increased accuracy, reduced setup time, improved uniformity, reduction in operator training, need for programmers
Information processing	Computers & business machinery to acquire, sort, manipulate, interpret, store, & display selected data Mechanical reproduction of selected data, forms, checks, & so on	Reduction of clerical labor Increased speed in preparing papers of all types Improved accuracy Speed in summarizing business conditions
Problem solving	Computer solutions of complex scientific, engineering, & business calculations Computer simulation of business & military problems Operations research problem analysis by computers	Solution of problems otherwise unfeasible Exploration of complex problems Decision making assistance on major business & military policies & strategies

FIGURE 6

CONSEQUENCES OF SCIENCE AND TECHNOLOGY

Bright, J. R. Opportunity and threat in technological change. Harvard Business Review, 1963, 41, 84.

1967, Vol. I) noted that in the early 1700's the factory system was started. Technological developments continued to improve the factory system where machines were substituted for hand labor and the whole concept of assembly took place under one roof. Complete mechanization and automation finally invaded this system production. Today the concept of the factory remains the same: production on a continuous basis under one roof or system. It is highly complex and involves many sophisticated systems. But the idea remains the same. Bright (1963) noted the factory production now involves some of these concepts:

1. Direct labor tasks.
2. Work feeding.
3. Materials handling.
4. Assembly.
5. Testing and inspection.
6. Packaging.

Machine age. The factory system and continuous production originated in the machine age.

Power age. The power age improved upon the factory system utilizing continuous manufacture and capitalized upon the idea of mass production. Oliver (1956), Silvey (Hilton, 1966), Walker (1968), Williamson (Kranzberg and Pursell, 1967, Vol. I) and Walker (Kranzberg and Pursell, 1967, Vol. II) defined mass production as production of standardized products in massive quantities for mass consumption.

Henry Ford's idea of mass production was the first significant example of the combination of science, technology and human resources coupled to turn out large quantities of complex products. Four factors contributed to the birth of mass production:

1. Advances in the production of metals.
2. Development of more efficient methods of generating energy.
3. Introduction and improvement of precision instruments.
4. Development of machine tool industry.

The mass assembly line was introduced to increase the productivity level of the nation's industries. The work environment changed rapidly and there evolved the idea of machine work pacing, repetition, minimum skill requirement and the requirement of more mental attention to the work function. With the advent of mass production came the "systems approach" which led to the concept of automation. Automation triggered an impact of industrial society which was entirely new to man.

Atomic age. Pregel (Fairchild and Landman, 1961), Oliver (1956), Miller (Allen, _et_. _al_., 1957), Walker (Kranzberg and Pursell, 1967, Vol. II), Buchanan (1965) and Laird and Laird (1964) noted that accompanying the atomic age in providing a better standard of living and the creation of new materials in conjunction with improved technology and scientific developments came another major development--

automation. Pregel (Fairchild and Landman, 1961, p. 37) noted:

> Automated installations are such lavish users of electrical energy that they can be operated only where the power supply is cheap and abundant. Automation is therefore the junior partner to nuclear power.

It is generally agreed that automation started during the atomic age because of increased electrical power. The automated factory was possible through successive stages of automatic control. Automation was defined as a modern term signifying the use of machines to perform work that formerly had to be done by humans. Oliver (1956, p. 634) noted automation as:

> An advanced mechanism through which production is increased through which quality standards are raised and controlled and through which production costs are cut by means of automatic machines, conveyor belts, electronic controls, feedback systems and brain-like computers. Automation not only replaces the muscle of man but also replaces part of his mind.

Automation means more than just labor-saving devices. It carries the implication that work is being done automatically by the machine. Automation is not a unique process that has just been developed, but implies more and better tools for doing a job more efficiently than was possible before. Three points were significant to describe automation:

1. The rapid and automatic processing of technical and business data by computer.

2. The expansion of the scope of mechanization

by transfer devices and the advanced techniques of handling materials and products.

3. Development of control over the manufacturing process and application of control to a wide range of industries.

Goodman (1957, p. 26) suggested that:

> Automation is the technology of automatic working in which handling methods, the processes, and the design of the processed material are integrated to utilize as fully as economically justifiable the mechanization of thought and effort in order to achieve an automatic and in some cases a self regulating chain of process.

The object of automation is clearly to make the best possible use of the existing and available resources such as machines, material, man and money. Figure 7 shows how automation has replaced certain aspects of man's activity and made the work simpler.

Bright (Kranzberg and Pursell, 1967, Vol. II) and Oliver (1956) indicated that automation developed in three significant stages:

1. Use of machines for the production process.

2. Movement of materials and finished parts from one work station to another.

3 Development of control systems that regulate the production system.

Oliver (1956) further stated that there was a need for automation because of the present-day system of complicated technologies. Many products are manufactured under complex conditions of speed, pressure, and chemical exchange which makes human control impractical and in some cases impossible.

EXAMPLES OF AIDS TO MAN		MACHINES THAT REPLACE MAN
Codes, Laws, Training	6. Social, Moral (Human Relations)	None
Information, Logic, Motivation	5. Creativeness (Plan, Solve Problems)	Computers to Some Extent
Slide Rule, Adding Machine, Cash Register	4. Simple "Head Work" (Read, Write, Figure, Remember)	Computers, Tape Controlled Machines, Calculating Machines, Automatic Typewriter
Eye Glasses, Microscope, Amplifiers, Gauges, Radar	3. Sensing (See, Hear, Smell, Touch, Taste)	Photocells, Gauges, Press Switches, Feedback Devices
Most Hand Tools, Linotype, Assembly Lines, Jigs, Fixtures	2. Dexterity (Hand and Finger Skill)	Self Feeding, Assembly and Transfer Machines
Levers, Rollers, Wheels, Pulleys, Lubricants	1. Muscle Exertion (Carry, Lift, Push, Turn, Bend, Squeeze)	Motors, Engines, Hydraulics, Fluidics, Compressed Air

FIGURE 7

THE TREND OF AUTOMATION IN TERMS OF HUMAN ACTIVITIES

Laird, D. A. and Laird, E. C. How to Get Along with Automation. New York: McGraw-Hill, 1964, p. 5.

Oliver (1956) and Bright (Kranzberg and Pursell, 1967) also stated that the development of computers was a significant step toward the achievement of control of automatic machines. The control over manufacture of discrete parts and operations was rare in the atomic age, but basic production lines could be effectively controlled. The basic goal or need of automation was not increased productivity but the desire for product quality and reliability. The causes of failures and the need for corrections and/or control gave rise to the automation procedure. The change of physical design of the product, and modification of equipment was necessary to change the nature of materials in line with automation procedures. Walker (Kranzberg and Pursell, 1967, Vol. II) noted that the impact of automation introduced special social opportunities as well as different kinds of social problems. It is important to note that automation in no way replaced mass production; in fact, it speeded up and enhanced the efficiency of the already existing mass production technologies. The introduction of computers and numerical control brought about new influences upon the social significance of automation.

The description of automation involves two elements: automation as a phase of social force and as a set of technical facts. It was during the atomic age that these concepts merged to influence national and world-wide industrialism. Ward (1959) and Buchanan (1965) noted that nationalism

and even internationalism was promoted by the development of automation, which gave rise to a whole new concept of socialization and interaction with other cultures. The very first fact about the world is that, owing to the activities of the scientist, industrialist and technician, the world becomes physically one world. Automation helped to enhance it. Vincent and Mayers (1959) presented a different view of automation as containing three phases of machine industry, mass production, and automation. Automation is interpreted as the third industrial revolution which will continue to influence the economic cycle in the future. Automation is a continuation of specialization. A. N. Whitehead (1953) stated that the rise of professionalism and specialization is closely mated with progress of science and technology. Automation represents progress.

With the advent of automatic production a new kind of problem was created which involved the human aspect between labor, management and industrial goals. The concept of work was drastically changed and the adaptation to change was difficult. John Diebold (Burke, 1966) noted that automation implies a basic change in our attitude toward work. There remains a great deal of factual information and economic questions unanswered. Figure 8 represents some of the major issues that labor is concerned with.

Lewis Mumford (Burke, 1966) noted that the control of machines becomes a significant factor in modern society and

MAJOR ISSUES	ACTION TO BE TAKEN
Industrial	By Industry
	Through collective bargaining establish provisions for
- Decreasing job opportunities	- Shorter work week
- Need for more job security	- Supplementary and fringe benefits
- Change in wage structure and job evaluation	- New systems of incentives
- No sharing in economic gains	- Higher wages
- Labor needs are changing; retraining necessary	- Earlier retirement, special funds
	- Retraining programs
National	By Government
- Slow rate of economic growth; GNP should grow at 5%	- Stimulate economic growth
- Earning increase to slow	- Promote federal training
- Too many economically distressed communities	- Greater aid to economically distressed communities
- High unemployment	- Increase unemployment benefit
	- Change social security regulations

FIGURE 8

AUTOMATION: LABOR ISSUES AND ACTION TO BE TAKEN

Diebold, J. Beyond Automation. New York: McGraw-Hill, 1964, p. 146.

that man's identity is slowly being lost. Man becomes a slave of the machine, and human worth and value are replaced by some form of inanimate control. Norbert Wiener (Burke, 1966) questions the management of automation, and the real danger that arises is that changes in our environment have exceeded our capacity to adapt. Galbraith (1958) pointed out that with the increase of leisure time a new type of society emerges where material goods become the center of social status and position in a community. Despite the increase in leisure time, productivity continues to be expanded.

Goodman (1957) supported the fact that good men must be selected and trained before automation in an industrial setting will be successful. The main problem of adaptation to change had to be overcome and new concepts of management were created. Figure 9 illustrates some of the desirable characteristics and conditions of good management.

Despite the problems, automation did create some benefits. Bright (Kranzberg and Pursell, 1967, Vol. II) noted that improvements in storage, production, transportation and distribution have become significant. Lower labor cost, increased productivity and increased capacity have directly resulted from automation. Bright (p. 654) maintained that:

> As new demands are placed on industry--for higher wages or better quality--further automation is encouraged. It will be applied to achieve whatever

Technical Matters Facing Management

Technical complexity	
Integration of processes - - - - -	material flow, flexibility
Use of new tools to assist decision making - - - - -	computer, production
Research and development - - - - -	controlling of work
Recruitment, training, development of staff - - - - - - - -	teams of personnel
Planning - - - - - - - - - - - - - - - -	efficient operation
Alteration of product design - - -	simplification, standardization

Management Must Be Concerned With

Human Aspect	Industrial Engineering
Utilization of Engineers	Company
Technical Innovation	Costing
Depreciation	Maintenance
Sales and Distribution	Management Training

FIGURE 9

TECHNICAL MATTERS FACING MANAGEMENT AS A RESULT OF AUTOMATION

Figure 9 is adapted from Goodman, L. L. Man and Automation. London: Unwin Brothers, 1957.

> economic, technical and social objectives are important to industrial society of a given time.

Arnold J. Toynbee wrote: "This twentieth century will be remembered as the era when benefits of civilization will have become available to the whole human race." He further noted that "mankind's hope of better things lies in a permanent industrial revolution."

Cybernetics age. The cybernetics age saw the same developments, but in a more refined state. Greene (1962) noted that cybernated production systems involved not only automation, mass production, automation and cybernetic systems, but they also involved greater detail of some of the following concepts:

1. Work study.
2. Motion economy.
3. Factory layout, materials handling.
4. Transfer machines.
5. Computers and the production technologist.
6. Statistical quality control.

Thurston (1963) suggested that modern production systems also involve product design, process design, and material flow. Thurston also noted that any production system will interact with other business systems such as marketing, planning, design and management. Industry today cannot function in a vacuum. Figure 10 illustrates a modern concept of a production system which represents a very recent method of combining all of man's knowledge into production. The most

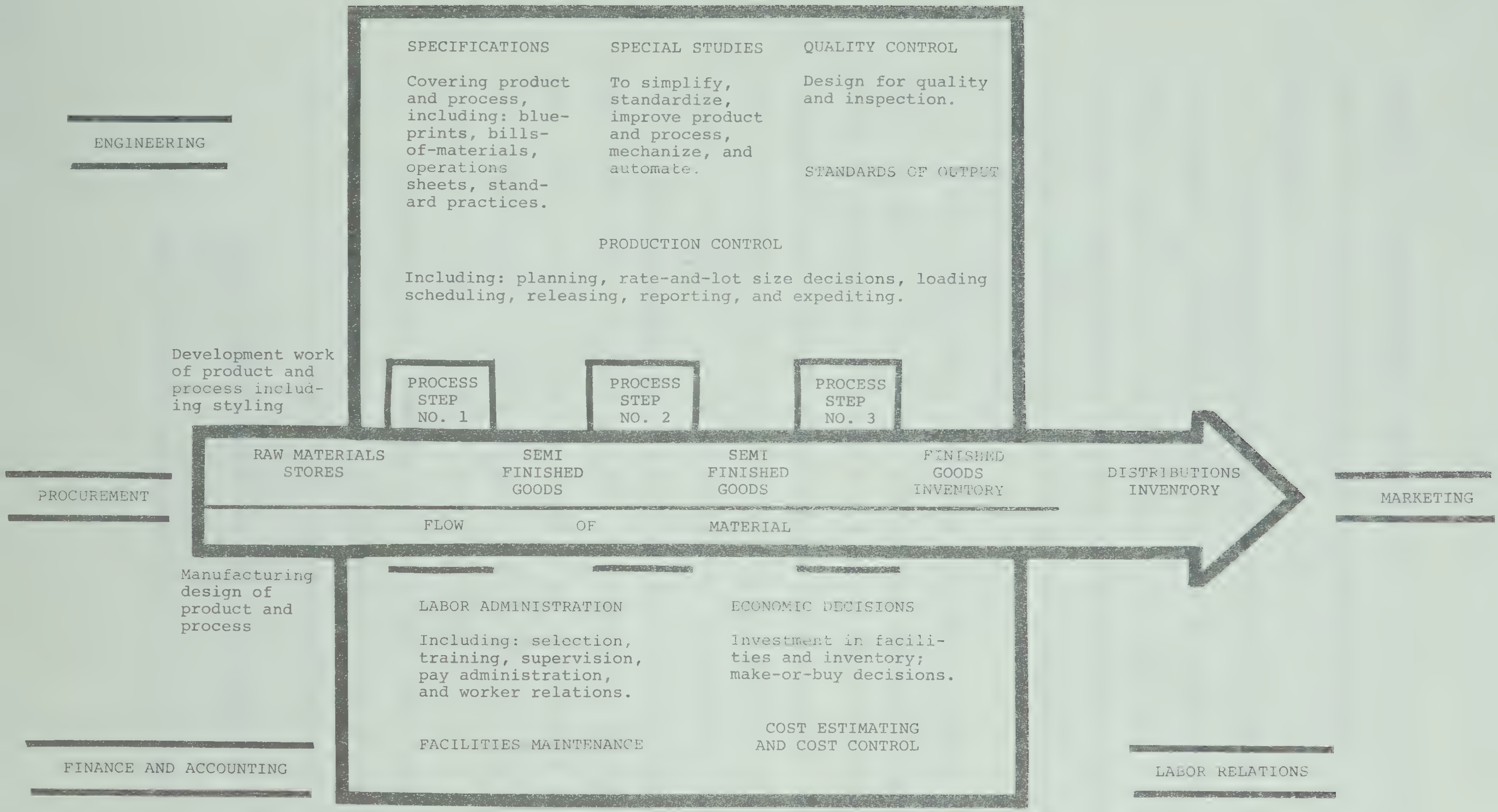


FIGURE 10

ILLUSTRATION OF A PRODUCTION SYSTEM

Having as core elements: Design of product, design of process and flow of material. Note:--This diagram is adapted from: Thurstone, P. H. The concept of a production system. Harvard Business Review, 1963, 41, 73-74.

effective and efficient methods have been devised to extract the most possible with the least possible cost.

Processes

Processes are closely connected with materials development, production systems, and are important toward overall operation of an industry. For example, the Bessemer converter was a process developed to produce high-grade steel which made possible some of the machine tools that are in production today.

Smith, Ferguson, Multhauf, Johnson (Kranzberg and Pursell, 1967, Vol. I) and Walker and Farber (Kranzberg and Pursell, 1967, Vol. II) showed a development of the various processes that had an influence on technological development, manufacturing, refining and production of new materials and products. This description is shown by each age.

Modern craft age. This age was relatively undeveloped and involved only simple iron casting and wood turning. The casting on process was also used where certain parts were placed into a mold and more molten metal was poured in to form a joint of the two parts.

Machine age. The machine age saw many more developments that were significantly influencial upon industrialization. Some of the following processes included were:

1. The puddling process was introduced, which was an improvement in the iron refining process.

2. Carburization process involved the case

hardening of steel.

3. The cementation process was closely connected with carburization where parts were joined and case hardened at the same time.

4. The process of using coal gas for heating and lighting was introduced.

5. Coal tar dyes were successfully used for industrial purposes.

6. Electro-chemistry was introduced, which later formed the basis for modern electro-chemical and electro-metallic processes.

7. Explosives signalled a significant development of science and invention.

8. The first samples of rubber were introduced, which later proved to be most beneficial.

Power age. The power age saw the use of many of the processes that were introduced up to this point.

1. Bessemer introduced a new process of making high quality steel on a mass production basis.

2. Mond found a way of extracting pure nickel and other metals by the electrolytic process.

3. The "Welsh" and the wet processes greatly simplified the refining and smelting process.

4. Sulfuric acid was first produced by the chamber process, which later was refined to utilize the contact process for this production.

5. Aluminum extraction process by electrolysis was introduced.

6. Soda ash, greater range of coal tar dyes and a greater refinement of the electrolytic processes were made more significant.

7. The process of heavy chemicals such as gypsum, borax, ammonium chloride and others were introduced by new refining processes. Plastic was being introduced by the latter part of this age.

The power age saw many of these processes triggered by a greater interest shown by scientists and engineers in the development of more reliable processes and materials.

Atomic and cybernetics ages. These ages were combined because the two ages were basically identical. Some new processes were developed and many of the processes already in existence were greatly improved upon. Some of these developments included a significant rise of process industries in such areas as coal, chemicals, oils and a greater refinement of basic steel. Some of the significant processes have included the production of fertilizers, gasoline and other fuels and drugs. The process industries were significantly different for several reasons.

1. Time is less important. A substance can be broken down or refined only so fast and mechanization can improve the efficiency but cannot speed up the process.
2. The process industries are economically more stable.
3. These jobs call for a greater span of attention.
4. The social relationships on these jobs are somewhat closer knit.

Some of the most recent processes have included:

1. A whole new world of chemical synthetics which produced new synthetic materials.
2. A new idea of processing opened up by the development of catalysts.
3. A wider and more efficient employment of the electrolytic reduction process.
4. More reliable alloying, annealing, heat

treating, plating, and annodizing.

5. New methods of organic refinement and synthesis.

6. Development of plastics, resins, coal tar distillates.

The most significant developments resulted in drugs, petrochemicals and plastics which extended man's control over his environment more than was possible before. Figure 11 illustrates some of the most recent developments in process techniques.

Transportation

Transportation was one of the major technological developments that introduced the concept of modern industrial society. As before, transportation depended upon other aspects of industrialization and became the one major factor responsible for the spread of goods and products over North America and the rest of the world. As Karl Marx (1967, p. 52) noted:

> . . . what the transportation industry sells is transportation, i.e., the productive process of the transport industry. Men and goods travel together with the means of transportation, and this traveling, this locomotion, constitutes the process of production effected by the means.

Modern craft age. It was noted in the modern craft age that transportation was simple and resulted in a slow process. Miller (Allen, et. al., 1957) and Oliver (1956) noted that early travel occurred when people navigated the rivers, bays and inlets along the coast. Shipbuilding and

Areas of Advance	Some Typical Means	Some Results
Alteration of living things: Longer life; Toleration of extreme climatic conditions; Control of growth, with respect to proportions & timing; & maximization of most valuable portions; Greater resistance to disease & accident; Elimination of undesirable life	Selective breeding; Development of hybrids & special strains; Special feeding & fertilizing; Protective treatment by antibiotics & chemicals; Environmental control of temperature & moisture	More economic value per unit; Usefulness maintained for longer times & over a wider range of conditions; Production possible in new regions; Demand for special treatments & equipments
Longer life for perishable foods & other organic products & items	Packaging methods; Protective environments, such as freezing, dehydration, & irradiation	Shelf life increased; Seasonality effects & limitations reduced
Reduced deterioration in physical goods	More durable materials; Treatments to inhibit insect infestation, corrosion, wear, fungi, & other factors; Better construction & design	Less maintenance; Longer life; Fewer parts

FIGURE 11

INCREASED ABILITY TO EXTEND AND CONTROL THE LIFE OF ANIMATE AND INANIMATE THINGS

Bright, J. R. Opportunity and threat in technological change. <u>Harvard Business Review</u>, 1963, 41, 80.

the construction of small water craft began in North America during this age. Inland water travel and road building appeared in greater strength. Land travel was done principally by walking and the use of animals to draw small wagons or carts. Inland travel was usually short and did not convey a great amount of goods or people at one time.

Machine age. With the introduction of the machine age came the advent of the steam engine. Ferguson (Kranzberg and Pursell, 1967, Vol. I) noted the introduction of the first successful steam boat on a commercial basis used both for ocean travel and inland waterways. The power age also saw the introduction of steam locomotives and the construction of railways utilizing steel rails. The early locomotives were simple and could not carry a large amount of goods, although it was a vast improvement over the modern craft age. Simple versions of the steam carriage for land travel were introduced. The refinements and the impact of mechanized transportation did not become fully practical until the beginning of the power age.

Power age. The power age was known as the "Railway Era." Burlingame (Kranzberg and Pursell, 1967, Vol. I) and Oliver (1956) noted that speed became the most important technological innovation of the transportation industry. The railway industry began to expand its railway systems to cover longer distances and to transport more goods and people at any one time. New and improved methods of rail

building were developed to enable the trains to travel through mountainous country. Iron ships were common and could carry a greater amount of materials than before. The greatest amount of produced iron during this age went into the production of rails and bodies for land and water travel. The automobile industry began with the introduction of rubber and some new alloys for the production of strategic parts. This significance was not realized until the beginnings of the atomic age. Some work and experimentation was being done on air travel. The transportation revolution of this age was a revolution of iron and production techniques. Three problems had to be overcome and refined before any significant improvement would come about:

1. Techniques for shaping metals.
2. Transmission of power.
3. Production of power.

Atomic age. It was not until the early part of the atomic age that transportation expanded to other modes of travel. Miller (Allen, et. al., 1957), Smith, Rae and Williams (Kranzberg and Pursell, 1967, Vol. II) noted that the most significant developments have been made on the motor vehicle and air transportation. The modern automobile was based upon the development of portable power, the internal combustion engine. The development of new materials and production systems caused the automobile industry to grow very rapidly. Commercial and special vehicles became important

toward the fast and efficient movement of goods across the country. The development of roads and bridges has caused many linkages with once inaccessible places and areas. Rail and water transportation have basically remained the same. Only refinements were developed to improve the systems as well as construction to carry large loads at greater speed over long distances. The use of electricity and diesel was common. Luxury passenger liners were a sign of increased travel and cultural interaction among people of the world.

Aviation developed the quickest of any of the transportation methods. Scientific research, engineering, mathematics, experimental testing, financial and industrial enterprise and government military encouragement brought about the shortest transportation revolution in history. Propeller and jet-driven aircraft were common and shortened travel time by a great length of time. The development of component systems, aerodynamics research, and new strength materials made possible a tremendous advancement of the development of not only military aircraft but civilian transportation as well.

Cybernetics age. The cybernetics age still further improved ground and air travel. Bright (1963) indicated in Figure 12 some of the most recent developments and achievements with respect to transportation. Rocket travel, rocket assisted aircraft, large freight carrying aircraft, and supersonic transports are marks of modern air travel.

Areas of Advance	Some Typical Means	Some Results
Mastery of greater distances in less time and/or cost	Jet transports Helicopters Ground effects machines "Piggy-back" rail transport Container ships & trains Pipelines Supertankers Passenger conveyors Hydrofoil boats	World-wide commercial & pleasure travel of up to 3,000 miles in 8 hours Overnight freight service nationally & to most international centers Specialized transportation systems for high-volume items or dense traffic patterns Specialized handling devices linked to these transport systems
Movement & operations in new media (1) Space (2) Underseas (3) Arctic areas	Aerospace vehicles Submarines, bathyscaphes, & aqua lungs Helicopters, Arctic housing, utilities, trackless trains, & living systems	Warfare in new mediums, with associated attack, defense, surveillance, & communications devices Development of new support devices Acquisition of scientific knowledge Beginnings of new commercial operations (e.g., communications satellites, weather stations)

FIGURE 12

INCREASED TRANSPORTATION CAPABILITY

Bright, J. R. Opportunity and threat in technological change. Harvard Business Review, 1963, 41, 78.

Electronic control of roads and airways are important toward development of more efficient and safer travel. The impact of transportation as noted by Vance (1961), Walker (1968), Morris (1967), Moore (1965) and Kendrick (1961) has provided an auxiliary service which was important toward the development of agriculture, mining and domestic and foreign trade. Inadequacy or withdrawal of this type of service constitutes one of the greatest barriers to economic development. Transportation improvements have been important for these reasons:

1. Reduced cost between producer and customer.
2. A wider market possible.
3. Decreased costs making specialization possible.
4. Expanding division of labor possible.
5. Increased exports.
6. Reduced spoilage and waste.
7. Overall economy stimulated.
8. Direct computer control possible because of the intensity with which transportation is being utilized.

Transportation today is being very closely and critically studied to attempt to derive the most efficient use of this service. Some of the concepts of research and development include:

1. Output.
2. Employment and index of employment.
3. Capital.

4. Electric railways.

5. Bus lines.

6. Local and high-speed transit.

7. Motor trucking.

8. Establishment of new airlines and waterways.

Communication Information

Communication and information developments are closely linked with transportation. The spread of transportation necessitated the spread and increased use of communication to better understand the complex technological issues which were quickly assimilated into the industrial world.

Modern craft age. The modern craft age presented the simplest and least developed methods of communication. Smith and Davis (Kranzberg and Pursell, 1967, Vol. II) noted that word of mouth and the use of a messenger were the most common means of communicating information to other people. Some writing and drawing were used, but they were not developed.

Machine age. The most significant development of the machine age was the printing of small newspapers that were carried in a mail system from community to community. The writing of letters was common and the use of water and rail were proficient means for mail transportation.

Power age. The power age was the most significant age as far as communication development was concerned, noted Davis, Smith, Fin (Kranzberg and Pursell, 1967, Vol. II) and Debner (Kranzberg and Pursell, 1967, Vol. I). Some of the

developments included:

1. Increased commercial use of radio communication.

2. Use of wireless radio transmitters and radio receivers.

3. Origins of very simple computer-like devices.

4. Person-to-person communication via some form of mechanization such as telephone, telegraph or radio.

5. The significant effectiveness of printing and newspaper distribution.

6. Beginnings of mass communication.

7. Use of photographic principles.

8. Widespread use of postal service.

9. Beginnings of audio-visual media.

Atomic age. This age saw the improvement of the methods of communication to a stage where the world was shrinking in size as far as being able to contact persons on other parts of the globe. Visual communication, apart from newspapers, became the most significant development. Some refined developments included:

1. Diversified uses of inks, pencils, paints, and various kinds and grades of paper.

2. New and improved pens and drawing devices, typewriter and new methods of offset and letterpress printing.

3. The increased use of color-sound motion picture.

4. Wide industrial use of the telephone.

5. The use of AM and FM radio and phonographs for entertainment purposes.

6. Development and refinement of television, microfilm, and magnetic tape applications.

7. The use of radar, two-way radio (mobile), electronic control, and the use of electronic computers to revolutionize the communications industry.

Cybernetics age. The cybernetics age was the scene of more diversified communication, as noted by Davis and Debner (Kranzberg and Pursell, 1967, Vol. II). The transistor became the advent of miniaturization of communication equipment and the development of complex and precise mobile equipment, laser beam, long-distance and interplanetary communication. Allen (1957), Nelson, et. al. (1967), Miller and Form (1964), Moore (1967) and Stokes (1968) suggested that a new concept of communication had emerged. Although it had existed for many years before, it did not come into full realization until the latter part of the atomic age and became industrially important in the cybernetics age. This communication pertained to the basic human relations in a work plant and then into larger organizations and corporations. The structure of industrial organization was such as to complicate the command of orders from superior to subordinate. Three kinds of communication came into existence. The first two were known as peer communication: (1) subordinate to subordinate and (2) superior to superior. The third was the line of command through the proper channels, either up or down, between superior and subordinate.

The very nature of "man-boss" linkage affects the

accuracy, speed and content of communication. The more channels that a response must travel through, the less accurate it will become and perhaps result in total inaccuracy. Some of the basic problems that interfere with good communication are time and space segmentation, organizational restrictions, social and cultural differences, and ideological contradictions. The biggest problem for management today is to achieve a system of accurate communication in order to establish a more reliable and efficient organizational function. Computers are a tool for improving this function. Some of the areas of productive society that are influenced by communication include:

1. Nature of human contacts.
2. Extension of social horizons.
3. Growth of public opinion.
4. Tempo of life and advertising.
5. Rate of social change.
6. External and international migration.
7. Political power and behavior.
8. Education (perhaps the most important).
9. Accelerated diffusion of communication in the fields of science and technological innovation.

Figure 13 shows some of the most recent innovations and improvements of the extension of man's sensory capabilities which represent communication.

Areas of Advance	Some Typical Means	Some Results
Vision	Radar Electron microscope Television Radio astronomy	Transportation & war operations under previously limiting conditions of darkness, fog, rain, & so on. Ability to "see" roughly 200 miles New knowledge of materials, biology, diseases New mode of education, news, entertainment Extension of knowledge of the universe
Hearing	Microphone & amplification techniques, magnetic tape recording	High-fidelity radio & phonograph equipment Sound detection for war & police use
Touch	Instrumentation & control combinations which identify minute or distant conditions, & provide for human response to alter them	Power-assisted machinery such as power steering, power brakes, aircraft controls Remote control of pipelines Radio-control drone aircraft, industrial cranes, & special vehicles
Power of discrimination--visual, olfactory, aural, & so on	Instrumentation to detect minute quantities & dimensions Measurement & amplification technique	Precise measurement, leading to new scientific knowledge, to delicate control, to safety devices
Memory (preservation of visual & aural impressions	Great advances in photographic sensitivity & accuracy of reduction Duplication techniques (Xerography) Instant preservation of vision & sound through video tape, magnetic sound tape, polaroid photography	New capability for recording & studying information for science, war, technology, sociology, business New entertainment devices

FIGURE 13

EXTENSION OF MAN'S SENSORY CAPABILITIES

Bright, J. R. Opportunity and threat in technological change. Harvard Business Review, 1963, 41, 82.

Labor

Without human resources industry could not have functioned. Labor and work have been closely related since the time of recorded history and the division of labor has always existed. Man was not aware of specialization as known today but it has characterized society and work particularly where technological advancement has taken place. Adam Smith (1937, pp. 3, 7) suggested that every man's job involved some small job or operation as a total part of the complete task. Division of labor was important, as it increased the productivity and quality of an individual's job. Smith noted:

> The greatest improvement in the productive powers of labor, and the greater part of the skill dexterity and judgement with which it is any where directed, or applied, seem to have been the effects of the division of labor. . . . the improvement of the dexterity of the work man necessarily increases the quantity of the work he can perform.

Caplow (1954), Miller and Form (1964), Vincent and Mayers (1959) and Mumford (1934) stated that the division of labor and the concept of specialization were almost the same. Technological change has brought about a structuring of the labor aspect of productivity. Division of labor is a feature of all productive societies and simply refers to the allocation of functions between man and machine. When the number of tasks in a factory system increases, the division of labor increases, which points to the multitude and complexity of tasks that must be performed. The organization in this case is usually quite complex and highly

structured. The division of labor in society is a cooperation effort. Three simple classifications of the division of labor were noted:

1. Horizontal process--specialization by function; a full job broken down into parts.

2. Vertical organization--the division of decision-making duties between supervisory and operative personnel.

3. Multiple group specialization--managers, workers, and customers have their own specialization tasks.

<u>Modern craft age</u>. This age possessed labor that was cheap and mainly manual and unskilled. White (Kranzberg and Pursell, 1967, Vol. I) and Kranzberg (1967, Vol. I) noted that only the craftsman possessed some skill which he used for his own business. The guild system was in full operation during this age, and the workers were not free on the labor market as is known today. Simple apprenticeship existed and the training was long and tedious.

<u>Machine and power ages</u>. Labor movements and organizations began to develop when the guild systems were abandoned, freeing the workmen to leave the rural areas and migrate to the cities where factories were being built. A review of literature showed that there were little or no significant labor organizations in these two ages. Child labor was extensively used and the working conditions in the factories were bad and uncontrolled. It was not until the end of the power and the beginning of the atomic age that

organized labor began to appear. Some significant developments began to take place which have revolutionized the labor factor up to the present date.

Atomic and cybernetics ages. These ages saw a tremendous increase in the labor force and along with the prosperity, problems were inherent.

Barbash (Kranzberg and Pursell, 1967, Vol. II), Vincent and Mayers (1959), Morris (1967), Miller and Form (1964), Nelson, *et. al.* (1967), Moore (1967) and Walker (1968) noted that labor had organized to a significant degree. Some of the factors that were included in this organization were:

1. Labor training. The basic educational requirements have increased rapidly to encompass the ever increasing complexity of the job tasks to be performed. On-the-job training was the most common means of placing a person in a work situation. Certain basic requirements must be possessed before an individual can be successfully trained.

2. Labor unions. Through the years of organization and bargaining labor unions have achieved:

    a. Security of wages and fringe benefits.
    b. Controlled working hours and conditions.
    c. Systematic planning of the work function.
    d. Guaranteed laws which protect and support the worker from unjust treatment by management.
    e. Maintenance of work practices, customs and job rights.
    f. Programs of training, rehabilitation, compensation and job displacement.
    g. Labor-management relations that have supported a desirable atmosphere for work.

3. Bargaining methods. Collective bargaining is the best method where both management and labor intelligently and democratically come to settlements on particular issues. A confrontation of work rules has been used by labor organization. The economic condition is used as a lever for increased wages. The unions wish to remain static in their organization, but changes are forming some disunity in the labor structure.

4. Procedures against management resulting in strikes, picketing and work-to-rule procedures. Other procedures have been used, but the ones listed here are most common.

5. Some labor organization problems, including:

   a. Worker displacement by automation.
   b. Greater "dehumanization" of work.
   c. The need to resort to political-type activities and procedures.
   d. Emergence of specialized personnel administration, which makes it more difficult to maintain present union organization.
   e. Organizing only unskilled and skilled: no organization of professional people. Only in a few instances has there been some professional organization, and this is different from the regular type unions. These organizations are more like professional associations and do not resort to the same techniques that the labor unions do.
   f. More competition being introduced into the labor market by engineers and technicians.
   g. Change introducing new concepts which require unions to adapt or curtail activities.

Figure 14 illustrates the formal structure of a union local, and Figure 15 illustrates the relationship between management and union in the social organization of work. Figure 16 shows the struggle for power between management and unions in and out of the work organization.

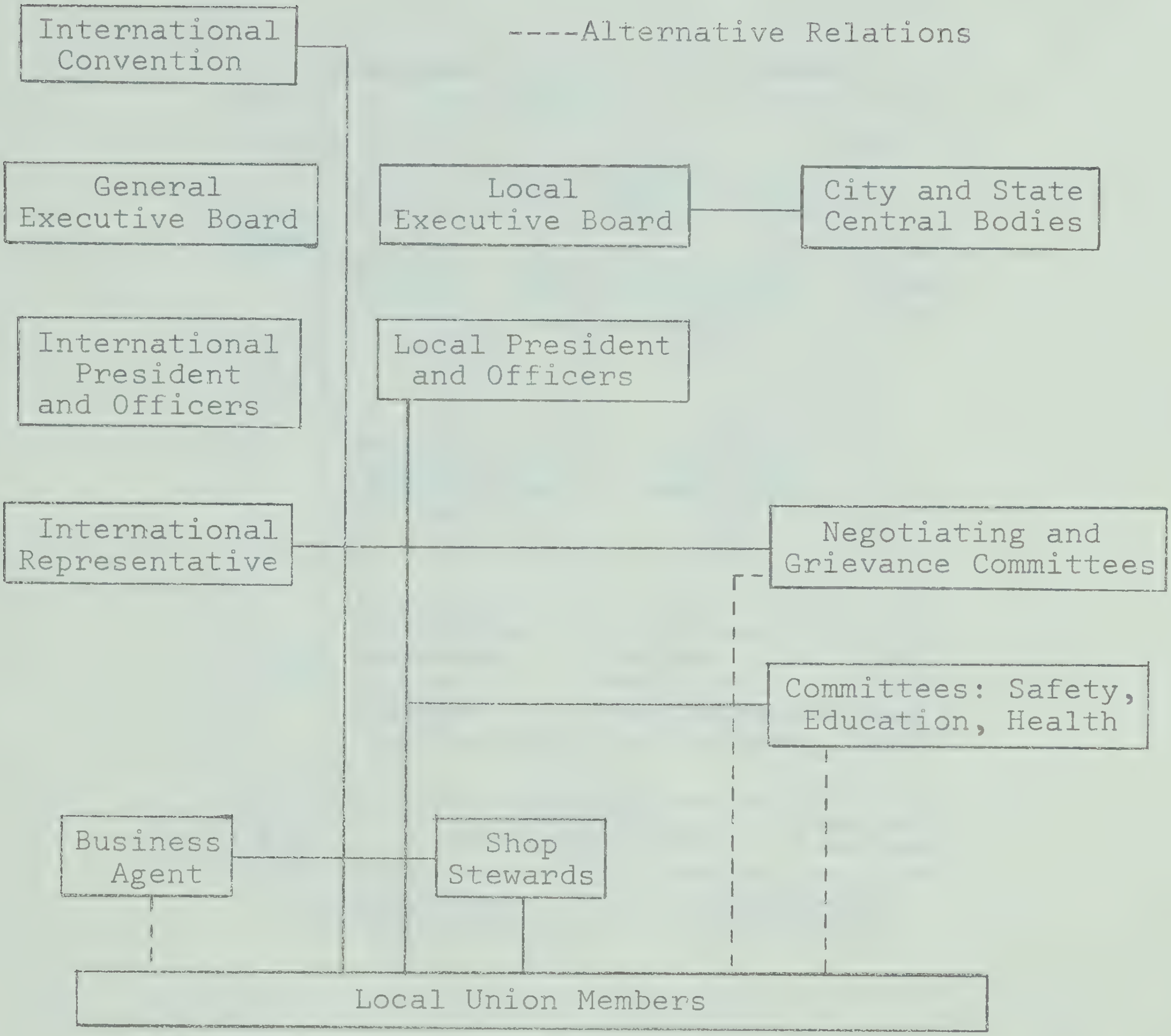


FIGURE 14

THE FORMAL STRUCTURE OF A UNION LOCAL

Miller, D. C., and Form, W. H. _Industrial Sociology_, 2nd Edition. New York: Harper and Row, 1964, p. 327.

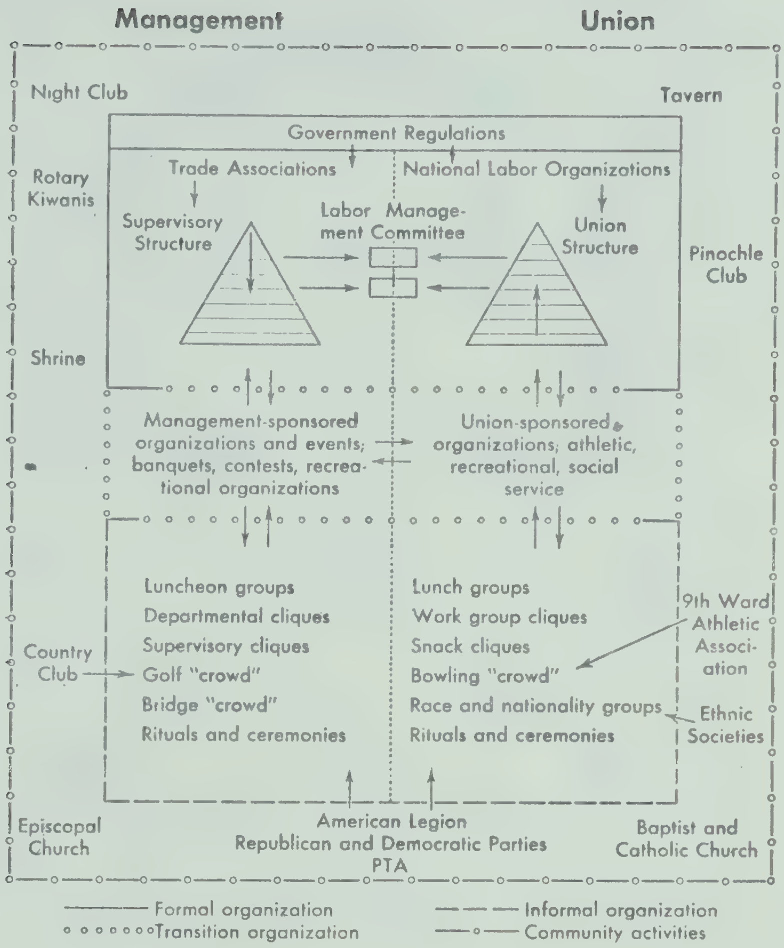


FIGURE 15

SOCIAL ORGANIZATION OF WORK PLANTS IN THE COMMUNITY AND SOCIETY SETTING

NOTE: This figure is reprinted from Miller, D. C., and Form, W. H. Industrial Sociology, 2nd Edition. New York: Harper and Row, 1964, p. 120.

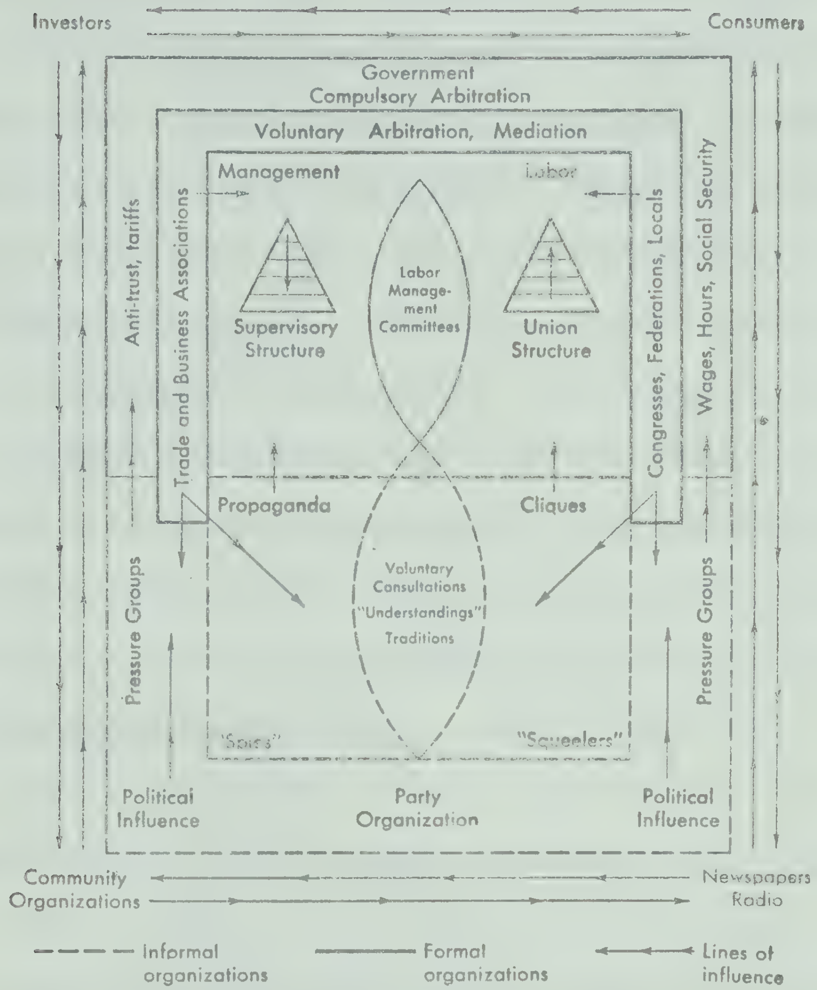


FIGURE 16

ORGANIZATIONS WITHIN AND WITHOUT THE WORK ORGANIZATION DRAWN INTO A STRUGGLE FOR POWER

NOTE: This figure is reprinted from Miller, D. C., and Form, W. H. Industrial Sociology, 2nd Edition. New York: Harper and Row, 1964, p. 372.

Management and Personnel

History shows that whenever a work situation has existed some subordinate-ordinate relationships always must be established. Some individual or groups of individuals will organize the work situation in order to meet desired objectives that have been previously established.

Modern craft age. The modern craft age did not possess any management-personnel organizations as known today. Barbash (Kranzberg and Pursell, 1967, Vol. II) noted that virtually no management organization existed. The craftsman was usually the sole owner and operator of his business. Family-owned organizations were also common.

Machine and power ages. These ages were characterized by the establishment of the factory system and the concentration of workers around manufacturing with increased productivity. Barbash also noted that beginnings of managers, foremen and inspectors became apparent during this age. Some beginnings of scientific management and control were noted, but these ended with the end of the power age. Rational standards of personnel and management did not start until the atomic age.

Atomic and cybernetics ages. These ages witnessed the rise of management and management operations and the improvement of these activities until efficiency and effectiveness of human control was achieved as we know it today. Personnel administration has sought and achieved

standards of rational management over the entire range of the employment process, from recruitment to retirement. Management essentially consists of personnel function and management. Miller and Form (1964), Vincent and Mayers (1959), Bryce (1960), Morris (1967) and Stokes (1968) noted that the management function is structured into what is called a formal organization of a company or corporation. A typical structure of the social organization of management is illustrated in Figure 17. This organization illustrates the structure of the various levels that are incorporated for a smooth, uniform flow of communication between the top management and the workers who actually handle physical materials for the production of goods. Some concepts included in this type of structure are:

1. Social organization--interrelationships between each member of the work situation.

2. Power groupings--structured from the top management functions to the bottom of worker organization.

3. Management functions of aims and goals of the organization.

4. Formal organization which represents the coordinated activities of two or more persons.

5. Informal organizations which include friendships among the people who work together.

6. The formation of bureaucracy which involves a hierarchical arrangement of unit organization. A unit organization represents the steps on the structural scale.

7. Smooth, uniform work flow for efficient attainment of organizational goals.

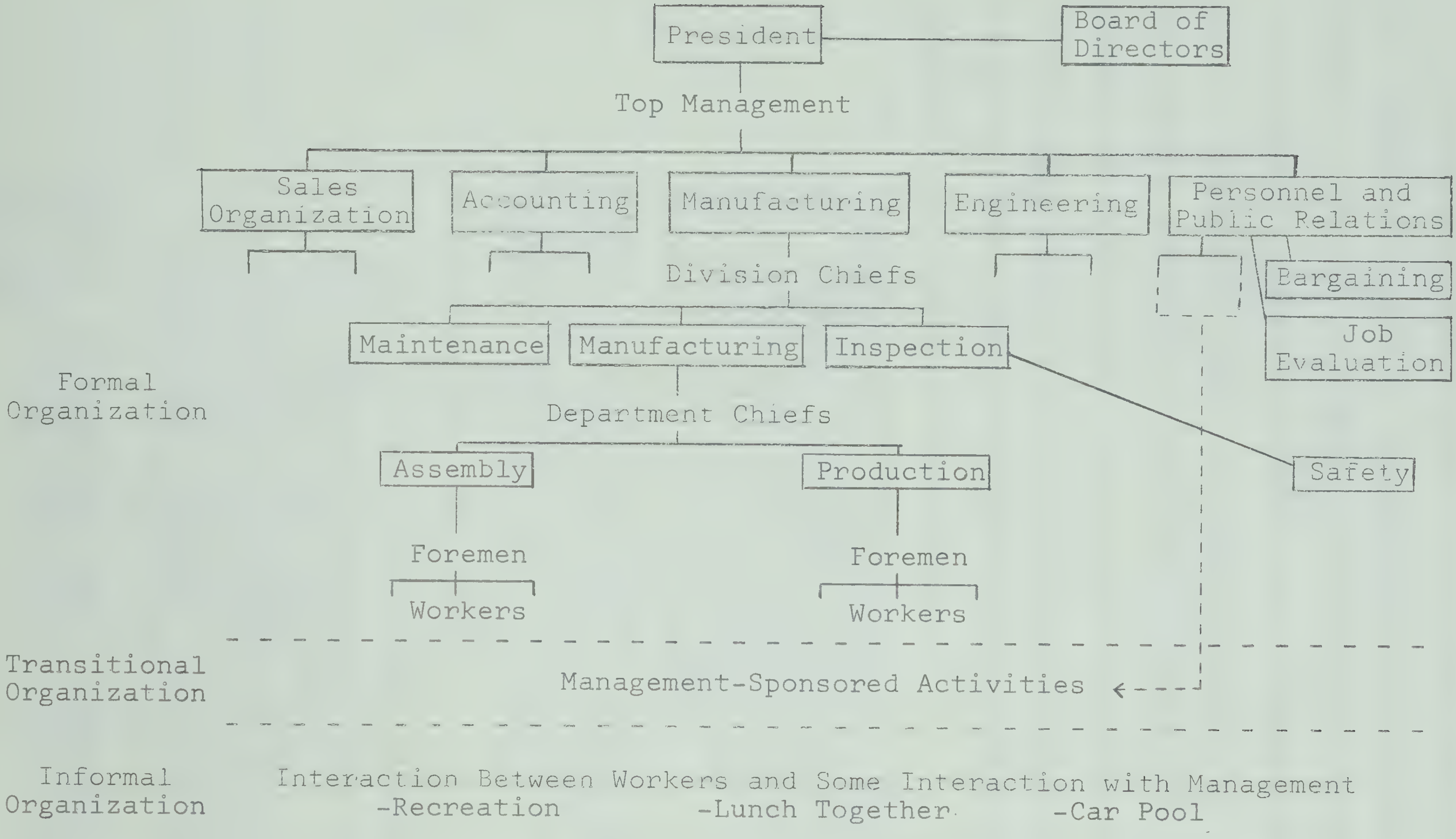


FIGURE 17

TRADE ASSOCIATIONS AND GOVERNMENT REGULATIONS

Miller, D. C. and Form, W. H. Industrial Sociology (2nd Ed.). New York: Harper and Row, 1964, p. 122.

Managerial and personnel roles and functions are the most significant part of the organizational function. It is understood that well qualified leaders are necessary before a well organized activity can be formed. The requirements of managerial roles and functions are noted as characterizing the functions of the formal organization and comprehend the total overall operation of a plant or other type of production system. Some of these characteristics, which are listed below, will indicate the overall methods of management and personnel organization.

1. Management tasks have changed to a stage where the manager is no longer a source of wisdom and technical knowledge for his subordinates. The manager has become a coordinator of experts within the organization, each of which will far outrank him as far as specialized knowledge is concerned. This type of situation creates added difficulties for management.

2. Essentials of good management include well structured and clear lines of communication between the board of directors, general manager, assistant managers, accounting, personnel relations, and marketing.

3. Some managerial roles include:

    a. Organizing and coordinating the work function.
    b. Organizing and coordinating other assistant and plant managers and foremen.
    c. Coordinating the economic factor.
    d. Ensuring and creating general policy.
    e. Coordinating and overall operating of the organization with respect to the board of governors, community, national regulations and market conditions.

4. Some of the goals and tasks of management were noted by Kotona, Drucker, Simon and Trow, and Moore (Warner and Martin, 1959). These included:

a. The formation of profit for the organization.
b. The production of goods and services for marketing for profit.
c. The management of the business, managers, workers and work.
d. The determination and establishment of policy.
e. The decision making.
f. The setting up of managerial strategies for a competitive market.

Economic Structure

Modern craft age. The economic structure was simple and beneficial to only a few who controlled the land and who collected money in lieu of certain performed services. Mumford (1934) and Clough (Kranzberg and Pursell, 1967, Vol. I) noted that this early type of economy was broken down because of the presence of private power and position. Certain individuals such as the landlords, princes and capitalists attempted to gain power and monopolize the functions of all forms of civic life. Public functions became private gestures. The church was the holder of economic activity and only a select few lived a life of luxury. The idea of wages and capital investment were very insignificant as is known today.

Machine age. The machine age was accompanied by the principle of increasing wants. Industry was beginning to produce a variety of goods to satisfy the material desires of the population. The economy passed from a factor of need to one of material acquisition. Needs became secondary and

to satisfy the wants became a symbol of society under the ever increasing "capitalist criterion." Capitalism and technology were different in many respects, yet one conditioned the other. The merchants accumulated capital by widening sales into new territories and the inventor carried on a process that paralleled the capitalist ventures. Greater opportunities for profit were provided with the development of modern capitalism and capitalist exploitation. Foreign trade became a significant economic gain along with lower costs, wider variety of goods, increased consumption and mobility of money. Banking became an extension of the use of money based on credit and the utilization of banking for more efficient business practices. The economic condition on the international market fluctuated many times as new channels for business opened up. The "feudal-manorial" system declined, cities increased, politics became more significant and increased demands for goods and services caused a more highly organized industrial system. A new economic theory was being developed which affected imports, exports and productivity. Most of the businesses were privately owned and private investment kept these organizations alive and increased the goods when the need arose.

Power age. This age was characterized by increased technological influence which caused vast changes in the industrial society. Rosenberg (Kranzberg and Pursell, 1967,

Vol. I) noted that conditions of supply and demand remained about the same as that of the machine age. Population increases brought about greater productivity, which meant the increases in business organization and increased capital investment into machines, factories, production systems and human resources. Increased input of capital and labor caused increased output of goods and services. The small scale privately owned businesses were quickly dissolved. The producing unit increased in size according to the amount of investment. Certain individuals would combine resources to produce a larger business unit. Increased demand and markets increased the demand for greater productivity. Large organized businesses were being developed because of the impracticality and inability of one individual to make sizeable investments.

Atomic and cybernetics ages. These ages are similar with respect to the economic structure. Rosenberg (Kranzberg and Pursell, 1967, Vol. I), Parsons and Smelser (1957), Nelson, et. al. (1967) and Bryce (1960) noted the speed with which the American economy had risen to very high levels. The output per capita was at an all time high and the prosperity of the country was on an increase. The American society was largely urbanized, and the major portion of the labor force was engaged in manufacturing and services. The economic activity was being organized into large industrial units such as the corporation. With threats of competition,

the rise of the population and an increased demand for a wider variety of non-essential goods, the economic development looked bright. Corporations, which became the single most important economic factor of America, were characterized by activities and situations which included:

1. The economy as a system.

2. The importance of the total social system for the consumption of goods and services.

3. The structure of new institutions which integrate new economic activity.

4. Organization of automation, machines, labor and natural resources for the most efficient type of production.

5. Concepts of credit creation on a wider basis, financing, stocks and bonds, public ownership, stock and market control, investing agents, production capacity, new value systems, capacity to assimilate economic innovation, and technological "know-how."

Figure 18 illustrates the economic cycle which portrays the economic structure of our society.

Cybernetics age. The cybernetics age was essentially the same as the atomic age. The only difference was the increase of capital expenditures and the increase of profits. In some instances profits were not the only means of operation, but a greater awareness of the society as a whole and activities were organized to benefit it. More government control was evident and government programs were designed to encourage capital investment.

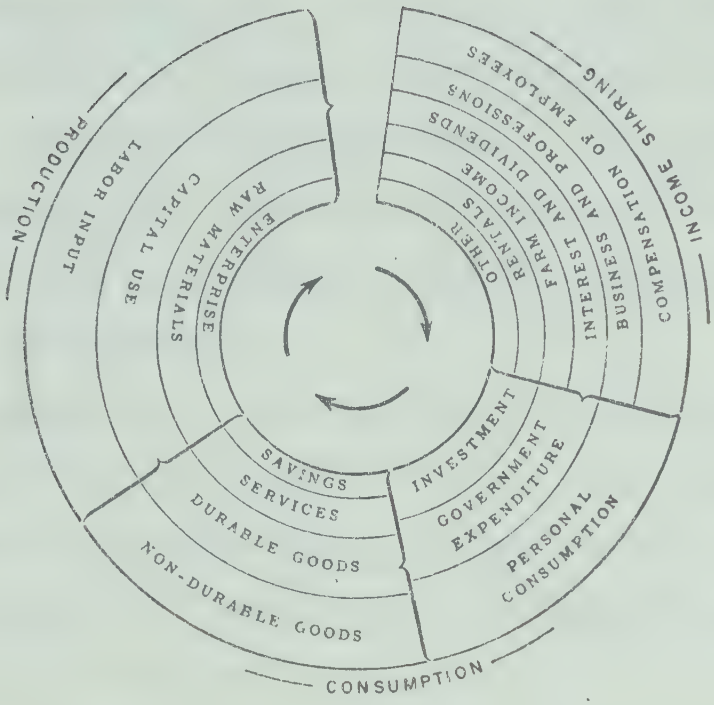


FIGURE 18

THE ECONOMIC CYCLE

NOTE: This figure is reprinted from Vance, S. Industrial Structure and Policy. New York: Prentice-Hall, 1961, p. 12.

Industrial Organization

Mumford (1934) and Rosenberg (Kranzberg and Pursell, 1967, Vol. I) traced industrial organization from the modern craft age to the power age.

Modern craft age. The modern craft age showed simple types of ownership, mainly private ownership where the landlord was sole owner and operator of a block of land with manual labor as the form of industrial activity. The private craftsman owned and operated a small business with low levels of productivity.

Machine age. This age saw the establishment and dissolution of guilds and other such simple organizations. Ownership of any significant business venture was private. The beginnings of a few large-scale industries were becoming evident.

Power age. The power age saw a more significant development of industry and business. The management of complex, large-scale enterprise, the increasing importance of decision making, long-term planning and the need for vast sums of financial resources made private ownership and small partnerships impractical and in some cases impossible. The development of the corporation was evident and its full impact was not known until the twentieth century.

Atomic and cybernetics ages. These ages saw the rise of the most significant economic factor--the corporation. Drucker (1964), Galbraith (1967), Morris (1967), and Gardner

and Rainwater (Warner and Martin, 1959) noted that "bigness" was associated with American business. The corporation was successful in establishing itself because of:

1. Its ability to handle the job of production.
2. Mass production's provision of goods of uniform quality and at a low cost.
3. Development in research.
4. Provision of more jobs and opportunities to work.
5. Association with the American social system forming a productive society.

Corporations are clearly responsible for the solid state of the nation's economy. Closely associated with the rise of the corporation was the growing significance of financial institutions, and capital markets. By issuing equity stock, the corporation draws upon the savings of large numbers of individuals, thus enabling the expansion of operations and development. A wide diversity of production and technological developments caused a series of industrial organizations which included:

1. Service industries.
2. Highly perishable goods processing, such as dairy products.
3. Handicrafts such as jewelry.
4. Regional production industries.
5. Development of transportation, power and communications industries.
6. Import reducing industries.

7. Production of simple capital goods.

8. Processing of agricultural goods.

9. Production of goods directly for consumption.

Peter F. Drucker (1964) noted that one of the largest corporations in North America, General Motors, has employed the concept of decentralization to a wider degree than was ever done before. Decentralization simply refers to the division of labor and has become the philosophy of industrial management of General Motors. It represents an outline of social order which includes certain advantages, such as the elimination of weak divisions and management, the elimination of the weak positions that are not clearly contributing to the organization, an increase in the speed of decision making, the absence of conflict of interests between divisions in the corporation, a sense of fairness to management and employees, a democracy of management, a large management group and the formation of a pool of experienced leaders. This type of industrial organization is commonly adopted by other corporations and large business enterprises.

Marketing

The structure of the market and marketing procedures are important toward the distribution of goods and the realization of profit for business enterprises. Drucker (1964), Parsons and Smelser (1956), Stokes (1968), Bryce (1960) and Miller and Form (1964) noted that every manufacturing enterprise needs to be market-oriented because a continuous supply

of customers and the development of new market sites insures the stability and production of a business enterprise. Every organization needs a sales division with a competent manager to meet the world of competition. The ultimate purpose of any productivity is to manufacture goods which will be consumed by someone to meet his needs or wants. Product design, specifications, packaging, sizes and styling all have to be market-oriented if the business is to realize a profit from its production. Every manufacturer will eventually realize that the product must be made to suit the wants of the customer, that it has to be packaged, displayed attractively and advertised, and that only a strong sales organization will sell large quantities. The element of competition is strong and must be overcome before large profits will be realized. The market portion of any business will have to be carefully studied before the position and planning of production will proceed. The entire economic system of not only one enterprise, but the whole country, depends upon the trade concept with other nations and the ability to compete with other manufacturers and producers to capture the market trade. It becomes apparent that the market economy will function in a market society, or societies that have goods to exchange or sell for money or other goods. Five kinds of markets have been distinguished, apart from foreign trade:

1. Free or marginal market--small businessman adjusting and operating on his own abilities; not very stable and functions according to national economy.

2. Self-controlled market--controlled by a few owners who consider only themselves.

3. Traditional markets--maintain tradition which has been established from generations ago.

4. Contested markets--presence of labor unions which affect the economic activities of the enterprise.

5. Administered market--characteristic of large-scale business and corporations.

A typical market position indicator is outlined below, as used by modern industrial firms:

1. Extent and nature of competition.

2. Amount of potential market.

3. Amount of available loans for expansion.

4. Size of loans available.

5. Economic conditions of the community or country where markets will be established.

Every economy must have some form of economic stability and advancement--marketing holds that key.

Bridenbaugh (1950) indicated the following factors about market development.

Modern craft age. The modern craft age saw the production of goods that were manufactured according to the quantities of orders placed. Demand usually exceeded supply as the productivity index was low and few large-scale craftsmen existed.

Machine age. This age saw trade with other parts of the country and an increased supply of goods that resulted from more manufacturers and the establishment of the factory system. Craftsmen and private owners handled their own sales.

Power age. The power age had increased markets to other nations and trading became common. Transportation was better developed and goods were better distributed to within almost every individual's reach.

Atomic and cybernetics ages. These ages saw the development of the most unique type of marketing system the world has ever known. Marburg (Kranzberg and Pursell, 1967, Vol. II) noted the establishment of wholesale and retail firms that distributed the goods all over the country. Fixed and controlled prices were common. Government control had to be introduced to control marketing procedures to protect the customers. Some of the marketing procedures that were established included chain stores, mail order houses, department stores, retail shopping centers, individual credit, supermarkets, systems for goods handling, computer utilization for stock control and distribution, modern advertising, and goods service industries.

Planning and Control

A review of literature showed that there were no significant methods or techniques used for production planning in the early years of industrialization and productivity

as known today. This concept is unique to the twentieth century, for it was when automation had full impact upon industrialization that planning and control was of prime importance toward effective and efficient operation of a production unit.

Modern craft and machine ages. The ages involved only the craftsman or the skilled operator, who performed simple planning and organizing of machines, tools and materials for manufacturing.

Power age. The power age saw the use of blueprinting, specifying, standardization, feedback and data processing. The real significance of planning and control belongs to the ages following the power age.

Atomic and cybernetics ages. These ages saw the use of intensive methods of production planning and mapping out operations for establishment of hardware and process techniques. Goodman (1957), DeGarmo (1957), Greene (1962), Morris (1967), Galbraith (1967) and Diebold (1964) noted that rapid social change meant an entirely new and ever more important role of planning and control of the economic production. Automation also influenced profound changes which resulted in increased complexities that had to be carefully dealt with. Planning has assumed a greater role for the following reasons:

1. The concept of change and its influence upon society and industry.

2. Change and demand for different types of products.
3. Shortened reaction time of management.
4. Introduction of new technological devices such as the laser, cryogenics, and molelectronics.
5. Shortened business and industrial practices.
6. Increased complexity of organizational procedures.

The procedures that are necessary for putting an idea into reality are illustrated in Figure 19. Many concepts are involved which illustrate modern-day technology. Programming is another technique that has been used, and it involves the most modern concept of industrial planning and control. Figure 20 illustrates the concept of the computer and the factors involved in its operation. Project planning involves certain concepts which must be thoroughly investigated before it becomes feasible. Modern capital is not investigated until certain steps are dealt with. Some of these steps include:

1. Feasibility study.
2. Removal of obstacles that may block development.
3 Proposals of projects that are adequate for the particular ideas presented.
4. Projective planning which involves the selection of a plan and more intensive investigation.
5. Target planning of placing the project into operation, provided the other plans favor this.

This will result into a deeper investigation which will include the human and physical resources available, economic

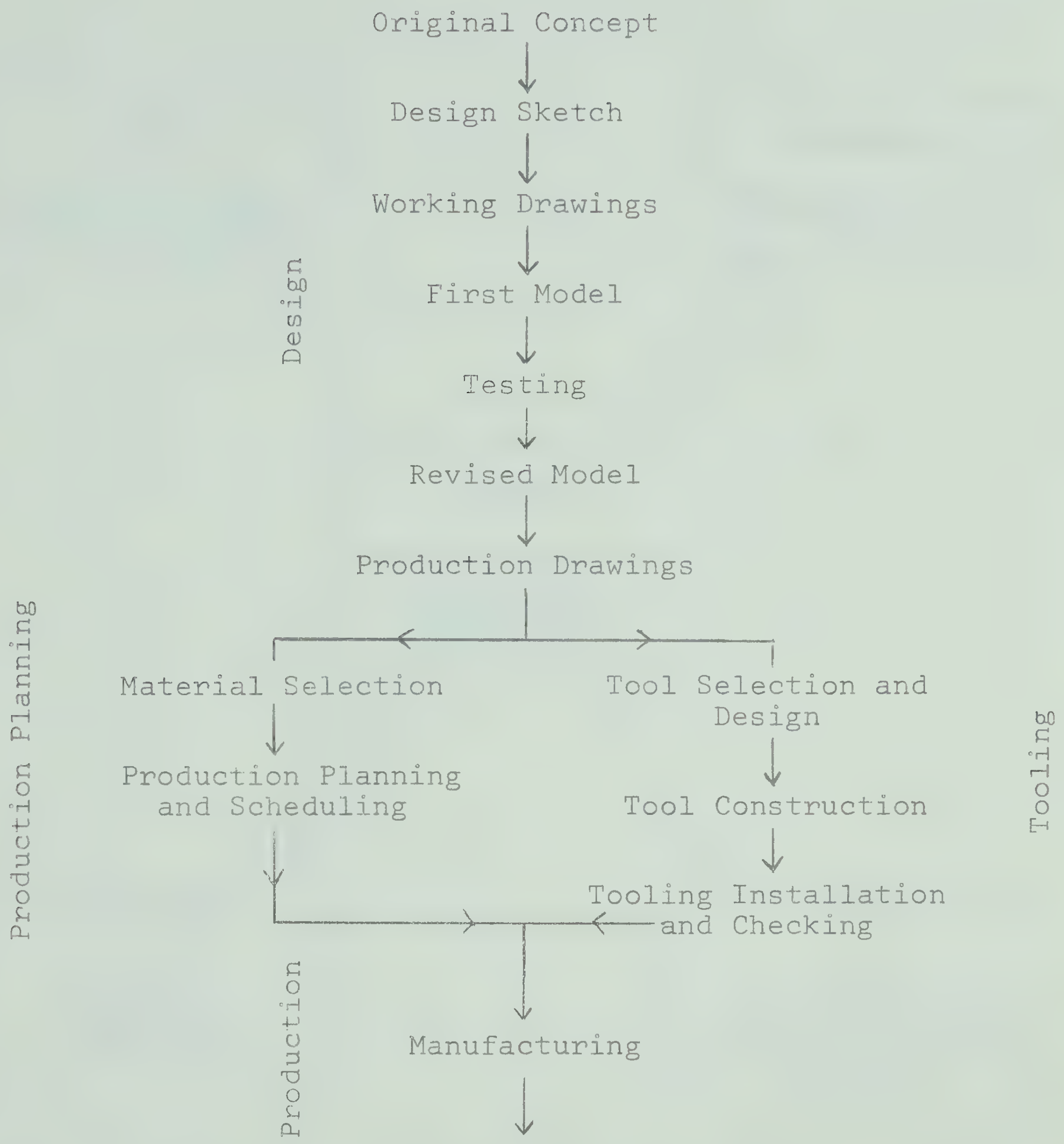
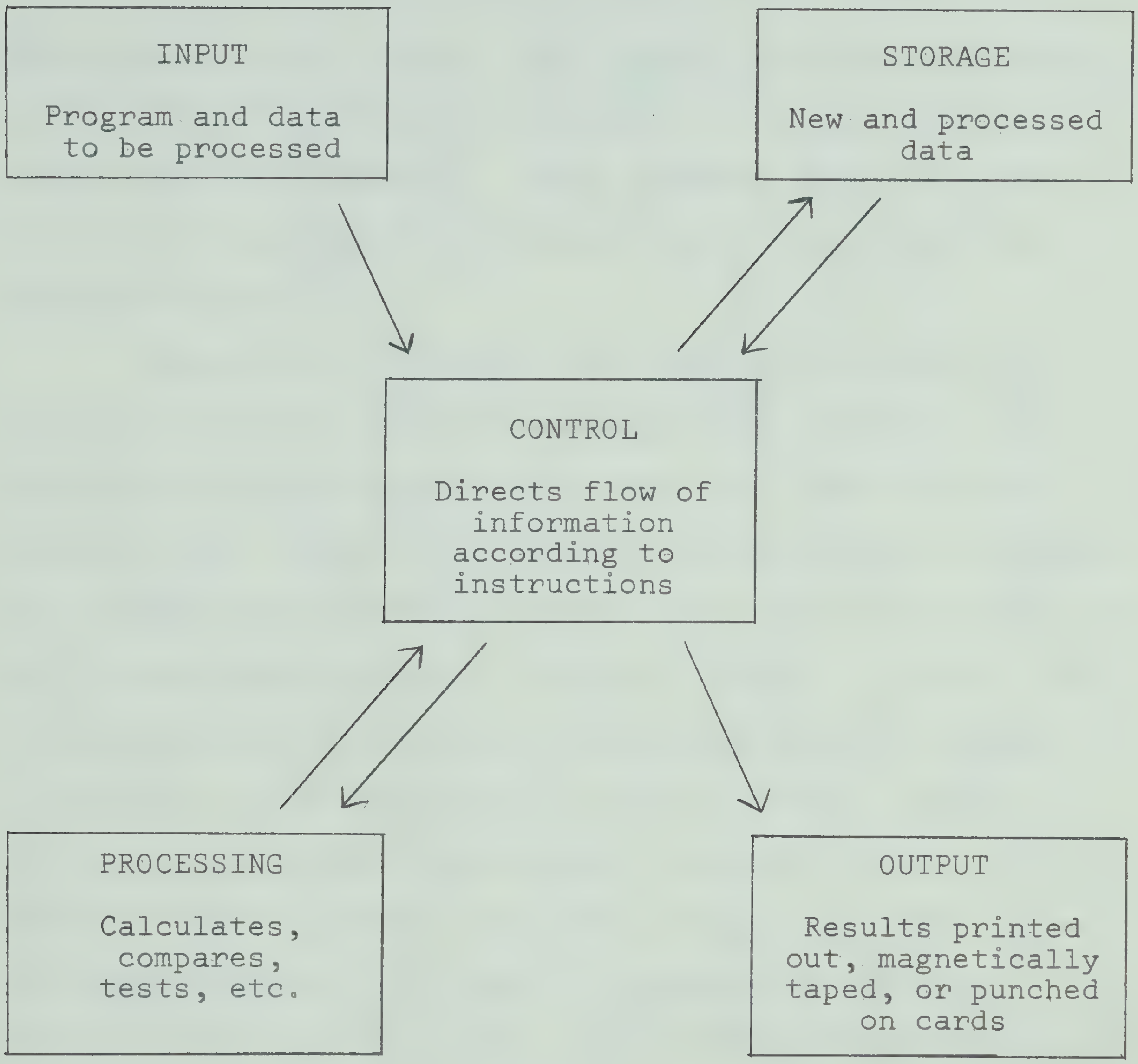


FIGURE 19

STEPS REQUIRED TO CONVERT AN IDEA
INTO A FINISHED PRODUCT

DeGarmo, P. E. Materials and Processes in Manufacturing. New York: Macmillan Company, 1957, p. 7.



New input data goes through control to storage. Control sends it with old data to processing and then back to storage or output or both.

FIGURE 20

COMPUTER COMPONENTS

Technology, the cybernated generation. <u>Time</u>, 1965, 85, 71.

overheads such as transportation and power, economic institutions available for support, the consumer market, the population and its composition, exports and imports, financial estimates, surveys of land use, and market surveys other than local markets. These elements constitute the process of planning and investigation before production and development.

Figure 21 illustrates how a typical business is organized and how various departments and individuals must be utilized before a plan can be put into practical and economic use. Figure 22 shows the various stages of feedback and closed-loop automatic control. This system is common in most cybernated production systems. Figures 23 and 24 show the development of production technology and work study. Efficiency is the highlight of these diagrams. Figure 25 shows how efficiency is graphically represented and idle periods of the operator indicated. Figure 26 shows how an automated process is planned and operates to the exact standards that were laid out. All of these diagrams represent the methods that are used for planning and control of production and show some of the factors that are critical toward efficient operation.

Training and Education

Education and training cover a broad concept with respect to the social system. For the purposes of this study education will be dealt with in an industrial setting

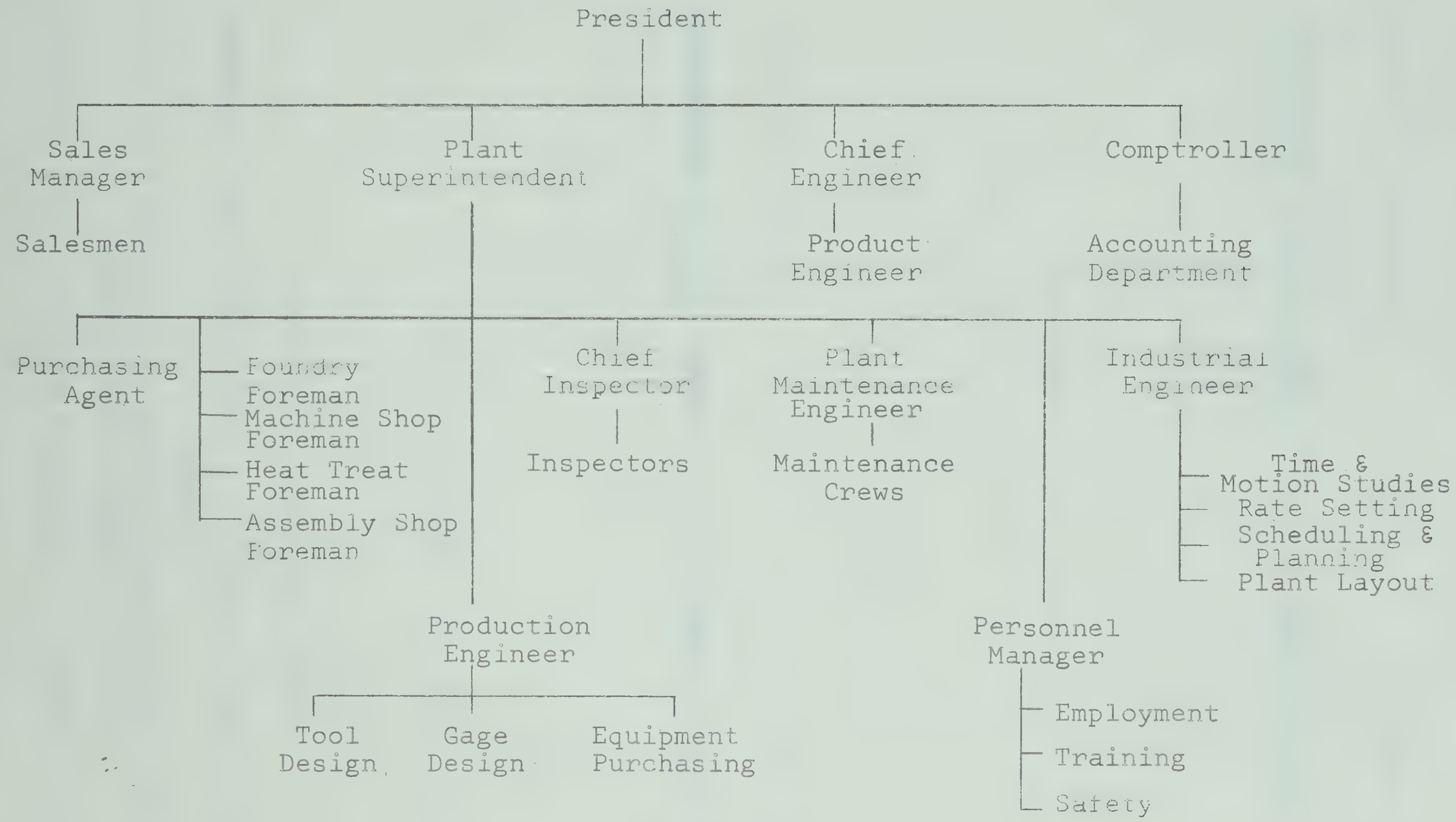
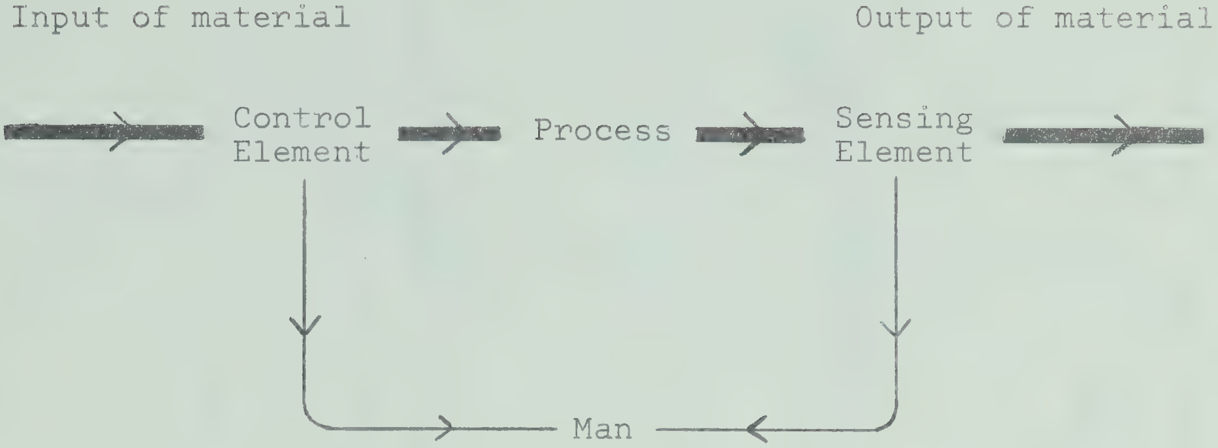


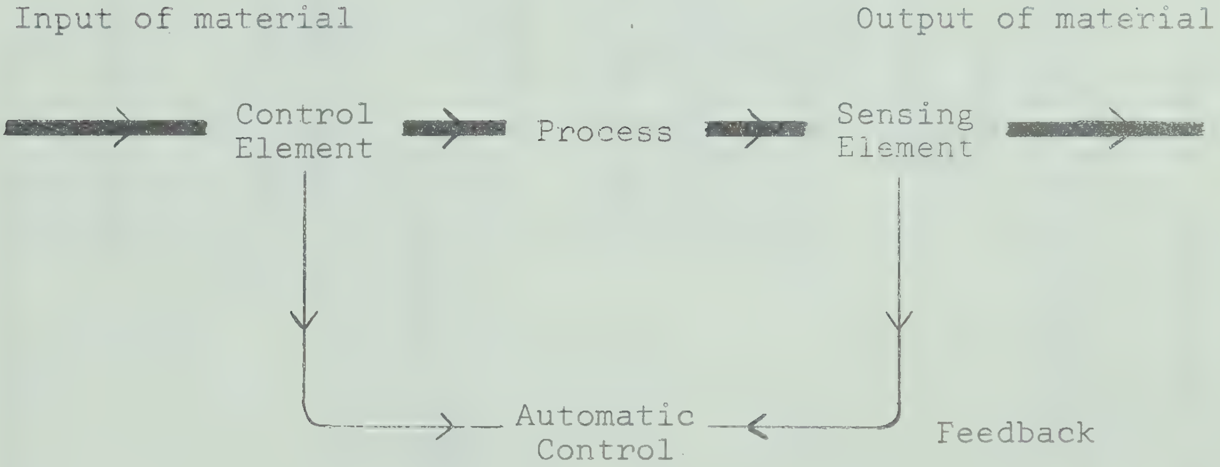
FIGURE 21

TYPICAL ORGANIZATION CHART OF A MODERN BUSINESS

DeGarmo, P. E. *Materials and Processes in Manufacturing*. New York: Appleton-Century-Crofts, 195[illegible], p. 9



MANUAL CONTROL



CLOSED-LOOP AUTOMATIC CONTROL

Flow of material   Flow of information

FIGURE 22

SCHEMATIC OUTLINES OF MANUAL CONTROL AND CLOSED-LOOP AUTOMATIC CONTROL

Goodman, L. L. Man and Automation. London: Unwin Brothers, 1957.

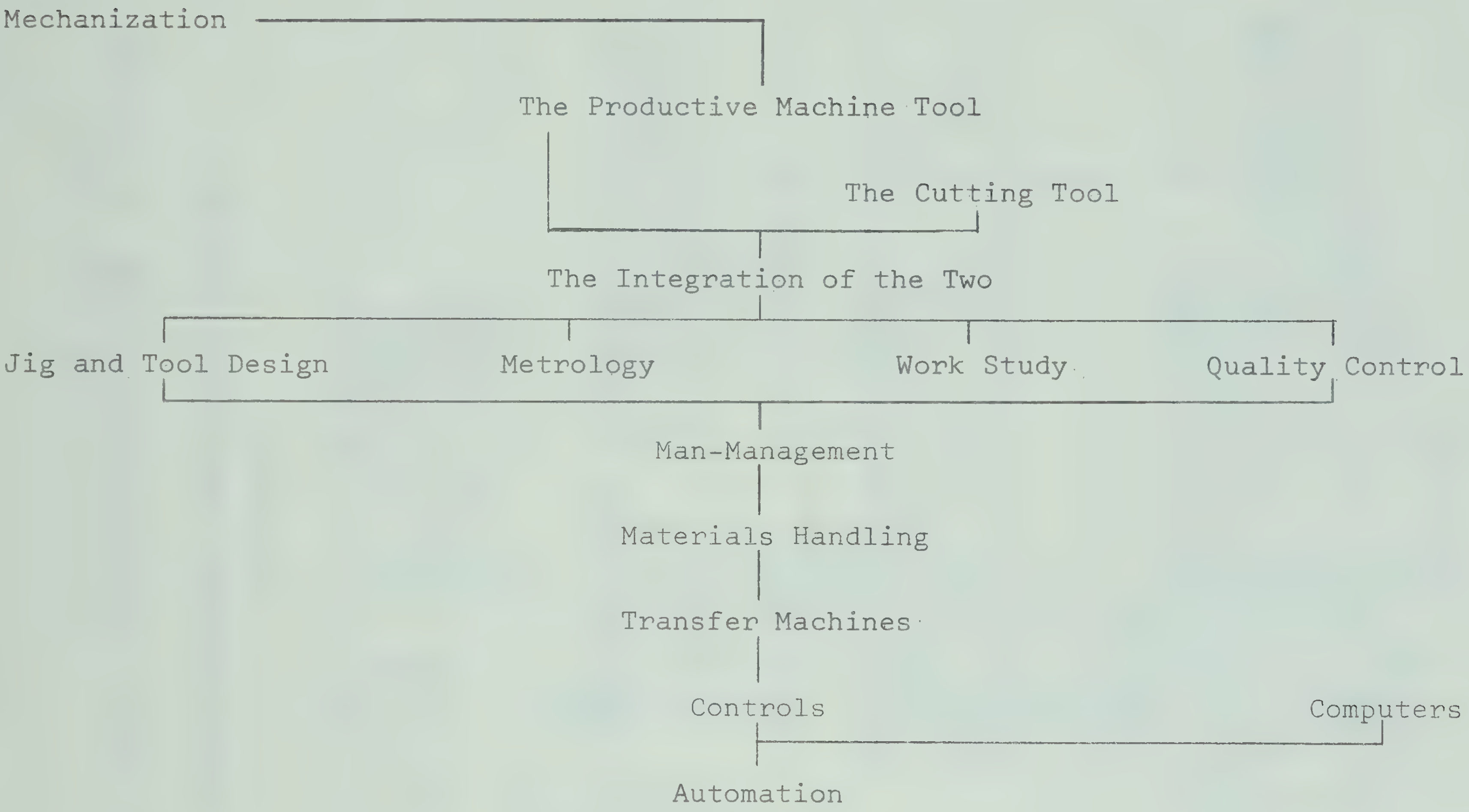


FIGURE 23

DEVELOPMENT OF PRODUCTION TECHNOLOGY
(With acknowledgments to Sir Walter Puckey)

Greene, D. E. <u>Production Technology</u>. London: Chapman and Hall, 1962, p. viii.

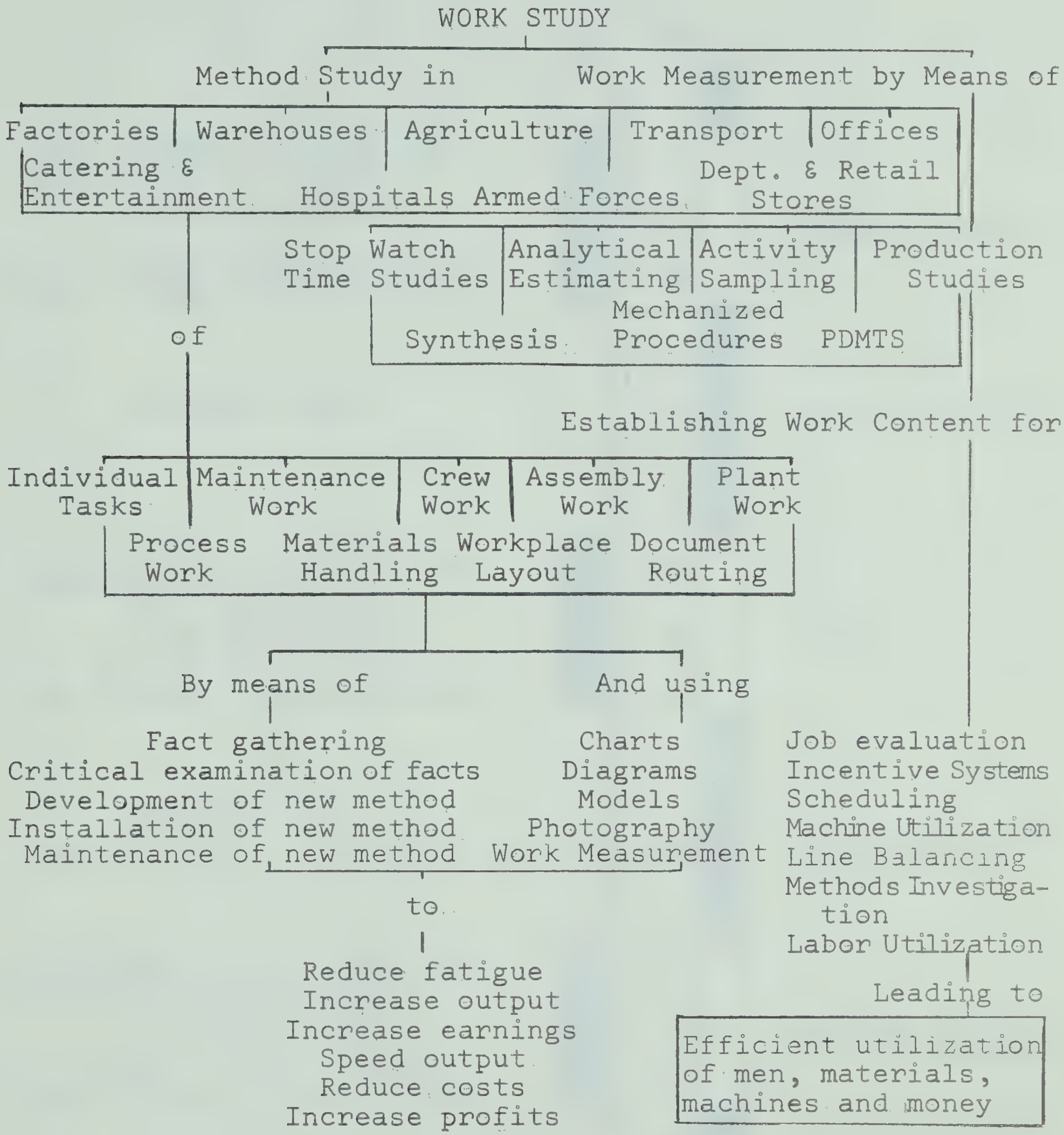


FIGURE 24

AN ANALYSIS OF WORK STUDY ACTIVITIES

Greene, D. E. Production Technology. London: Chapman and Hall, 1962, p. 2.

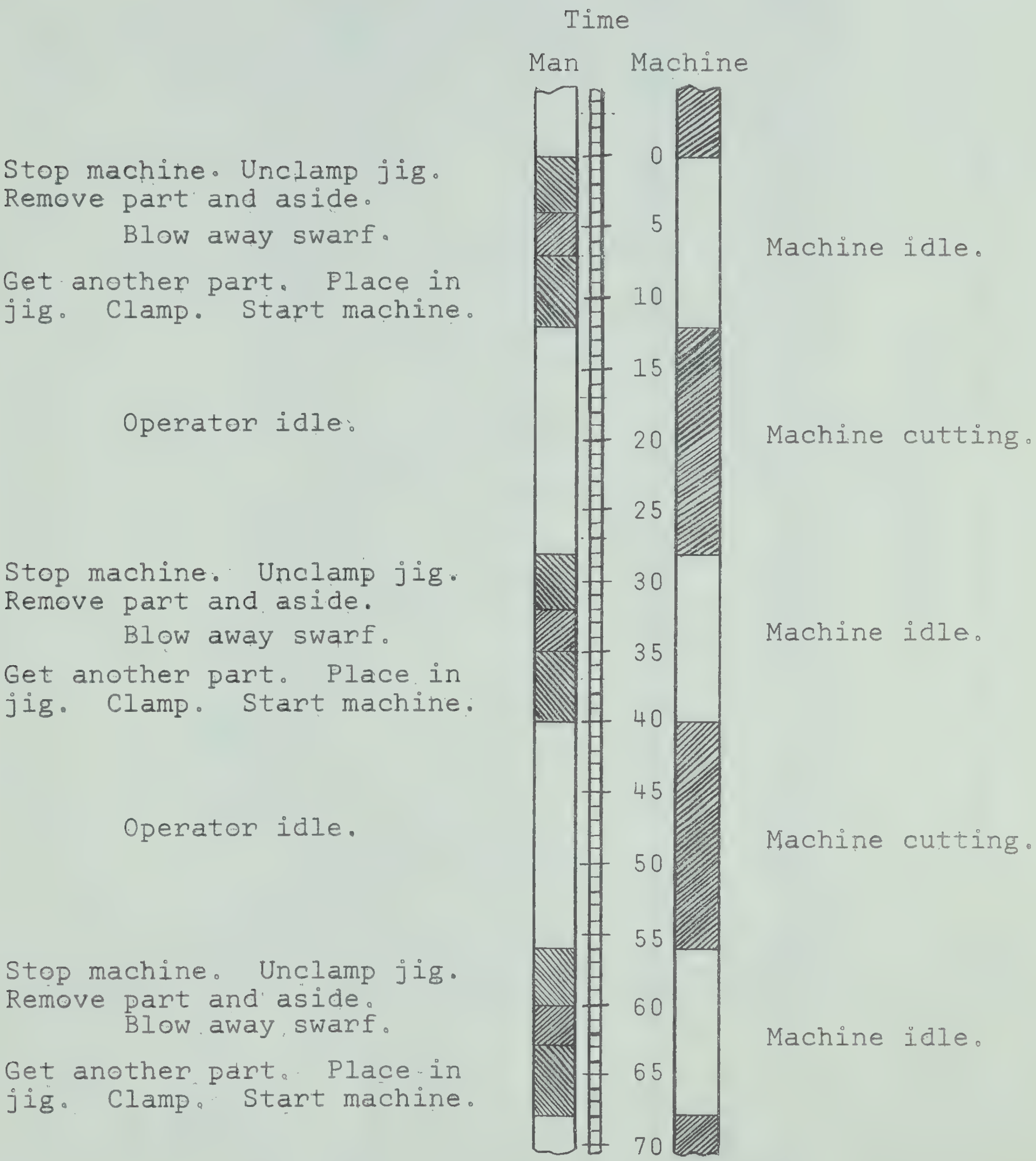


FIGURE 25

MULTIPLE-ACTIVITY CHART SHOWING UP IDLE PERIODS

Greene, D. E. Production Technology. London: Chapman and Hall, 1962, p. 9.

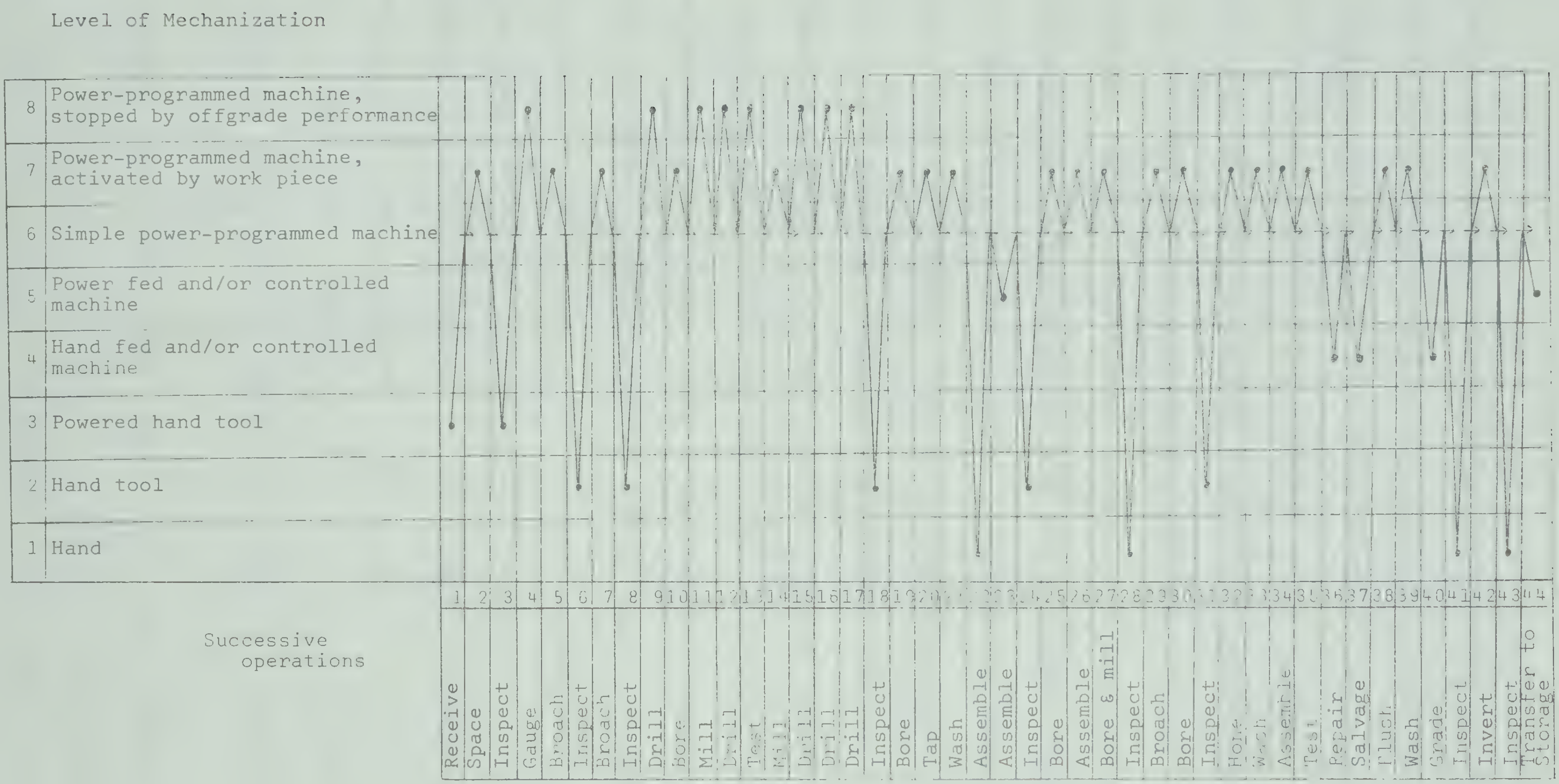


FIGURE 26

THE MECHANIZATION PROFILE

Solow, H. Automation: News behind the noise. Fortune, 1956, 53, 150-55.

where labor and management will be examined in terms of the training that is required for the changing concept of work.

Modern craft age. The modern craft age did not involve any complex training according to Barlow (1967). A thorough training was provided for those individuals who were accepted into the apprenticeship program of the craft guild system. The educational activities involved children at the elementary school level who were taught the elements of religion, writing, reading and arithmetic, usually by some member of the clergy. After a certain age individuals were placed in care of a master craftsmen and were trained in the manual skills of a particular job or craft.

Machine age. This age saw the concept of apprenticeship increased and become more involved for the trainee. Sherwood (Kranzberg and Pursell, 1967, Vol. II) noted that the governments influenced some technological developments by supporting technical training and education. The first engineering schools appeared in this age. Grants began to be developed by the governments in order to further support technical education. Because of a poor economy and limited technological development education did not significantly increase in quality.

Power age. The power age saw a mass reform in educational and training activities. Sanford (Kranzberg and Pursell, 1967, Vol. I) and Sherwood (Kranzberg and Pursell, 1967, Vol. II) noted that education became more significant

during this age. Scientific knowledge was more widely diffused and technological implementation of knowledge was possible on a larger scale. Mass education was more common and the beginnings of industrial training programs became more evident. Economists were aware that the economic strength of a country was based on the education of the labor force to higher standards so that they could occupy a better place in the productivity of the country. Some of the significant developments of education at this time were:

1. Greater federal support and aid to the development of education and research into education programs.

2. Government support for technical research and grants for specific technical achievements for laboratories and other technical institutions.

3. Greater concentration of improvement of schools and more stress on the science and the mathematics disciplines.

Atomic age. The atomic age witnessed a different orientation and value scheme for public education. Miller and Form (1964) noted that the major value orientations of business with regard to education included training youth to be law abiding and industrious, having efficient educational administration, securing suitable vocational training for future manual and clerical workers, assisting educators to actively endorse the American free enterprise system, and attempting to provide the best quality academic general education to prepare individuals for white-collar

business and professional occupations. There was a concern over the types of activities that schools were endorsing and various influencial industrial personnel were attempting to place education more in line with industrial thinking. It became well known that manual labor was to be avoided. Education provided a step into the white-collar occupations.

Walker (1968) and Stokes (1968) contended that education of the labor force was increasingly highly specialized and skill-oriented. Various kinds of skills of manipulation which involved greater mental power were developing, different from those kinds of skills of the modern craft age. Technical, administrative, and human relations skills were more important, and training had to be able to meet these requirements. Industrial training was of prime importance and many businesses provided on-the-job training or financial education in well qualified technical schools and universities.

Cybernetics age. The cybernetics age was essentially the same, except for new kinds of problems. Diebold (1964), Morris (1967), Galbraith (1967) and Nelson and Associates (1967) noted that cybernation has brought about a change in the values of society and will ultimately affect every individual. Donald N. Michael (Kranzberg and Pursell, 1967, Vol. II, p. 668) noted:

> . . . cybernation will have a major impact on the processes and purposes of education. The ability to work skillfully, to use leisure rewardingly, to participate as citizens in a changing democracy, and to acquire the values appropriate to the kind of world we have, will depend finally on education.

The concept of leisure time has become more apparent. Automation is replacing more workers and shortening the working period for those who remain employed. The unskilled individual faces a life-long process of education in order that he may continue to work. There will have to be constant retraining for the skilled and the professional. There will also have to be longer periods of formal education for the youth that will be entering the labor market. The idea of an efficient labor force becomes important because it must function in an efficient industry. The worker must not only seek industrial employment, but he must also have an incentive to increase his efforts and develop efficient methods of working. Manpower programs have been developed by the government to facilitate this type of training and retraining. The concept of change is more significant and education must not only cope with change but also take advantage of it to benefit the individuals of our productive society. Education must meet long- and short-term needs of industry and society as a whole. The capacity to adapt to a new environment has become the single most important goal of modern education.

<u>Occupations</u>

<u>Modern craft and machine ages</u>. A review of literature indicates that occupational structure and mobility did not exist in the modern craft and machine ages as is known today. No literature could be found to support this statement, but implications indicated that the division of labor acted as a primitive type of occupation scale. Every member in a social system was assigned a work role by the family group, the landlord or the factory operator. Class levels did exist, but these will not be discussed for the purposes of this study.

<u>Power age</u>. The power age saw the beginnings of occupations. Caplow (1954) noted that the first occupational scale was made during this age, in which occupations were classified in some form of order. This list contained about four hundred occupations and one hundred years later the United States Census Bureau listed about twenty-five thousand occupational titles. Occupational concepts are closely related to work which has already been discussed. The most significant factor to note about occupations at this age is that specialization and differentiation of tasks were occurring and people were conscious of it.

<u>Atomic and cybernetic ages</u>. Caplow (1954) and Nosow and Form (1962) contended that occupational position is an important factor in the determination of individual prestige and the allocation of certain types of social privileges.

Three general trends in occupations can be distinguished:

1. Rationalization, indicating that one's occupation was chosen on the basis of character, intelligence and ability.

2. Aggregation, indicating an occupation that was acquired through inherited ideals.

3. Differentiation, a combination of inherited ideals and the choosing of an occupation based on scientific principles.

Aggregation and differentiation of occupations have almost disappeared and do not have an influence upon an occupational career. Occupations in their modern form are results of the economic factor of industrialization and will continue to have influence upon the world of work. There does not seem to be a significant differentiation between occupation and work. Occupation refers to the classification of work while work involves the actual physical activities of a job. Both terms seem to define the same thing. A basic classification of occupations is noted below:

1. Business executive--owners or managers of banks or factories.

2. Professionals--lawyers, engineers, physicians.

3. Small business--owners and managers of small retail business.

4. White-collar workers--clerical and technical workers.

5. Skilled manual workers--bricklayers, plumbers, machinists.

6. Semi-skilled manual workers--truck drivers, machine operators.

7. Unskilled manual workers--sweepers, porters, janitors.

This scale does not necessarily indicate the hierarchy of the occupations listed. Caplow (1954) noted that two problems become inevitable when occupations are classified:

1. There are a number of classifications that cover too wide a range on an occupational scale and cannot be accurately assigned. These can include salesmen, retail proprietors, criminals and farmers.

2. Occupations differ in definiteness: policemen, janitors, trades and crafts are easily recognized. Categories such as countermen or vitrifiers are not easily recognizable.

Peter M. Blau and Associates (1956) noted three basic reasons why individuals choose a particular occupation:

1. The social structure to which the individual belongs and possibly the position of parental social status influences the occupation that could be chosen.

2. The psychological factor of the economic influence and desire for economic stability and material goods influences the occupation.

3. The process of motivation toward self-achievement will also influence the occupational choice; for example, the choice between a professional and skilled manual occupation, where the professional occupation requires more formal training.

Occupational choice is a development over years of growth and interaction in the social and educational environment. There is no single time when a person makes a choice of a single career. Occupational choice becomes a process of compromise between preferences for and expectations of a particular career pattern. The whole problem of choice involves a series of decisions that must be based on sound

judgment. Early determinants of occupational choice are usually used to make later choices and perhaps final ones. In some cases occupational choices are influenced by labor shortage, new industrial projects that require less skillful work or even technological reorganizations of existing industries that will accept less skillful workers. Figure 27 illustrates a conceptual framework for the process of occupational choice and selection.

Services

Modern craft and machine ages. A review of literature has shown that service industries did not exist in the modern craft and machine ages. Although the term "services" is used to a certain degree, no explanation or frame of reference has been issued. Service industries are a concept which were present in the atomic and following ages.

Power age. The power age saw the use of some type of service in the form of machine maintenance and other forms of work that did not involve the production of goods. The concept of service and service industries began in the early 1900's.

Atomic and cybernetics ages. These ages were significant for service because of demand for the type of work which did not involve the production of goods. Figure 28 shows the types of occupations that typically make up the service industry. It is not complete but represents the most common type of services that have made a significant

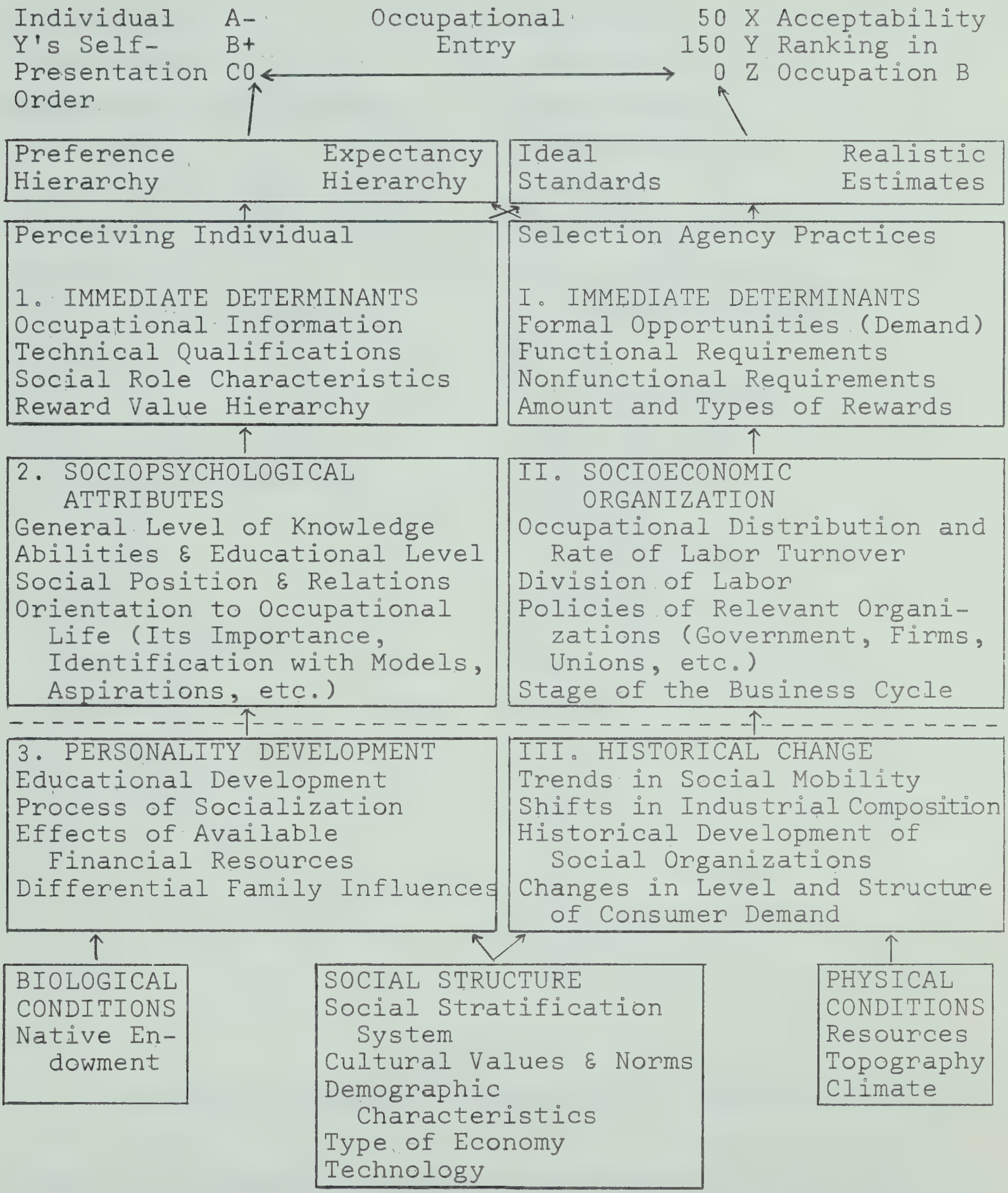


FIGURE 27

SCHEMA OF THE PROCESS OF OCCUPATIONAL CHOICE AND SELECTION

Blau, P. M., et. al. Occupational choice: A conceptual framework. *Industrial and Labor Relations Review*, 1956, 9, 531-543.

Bus drivers	Architects
Carpenters	Postmen
Department store clerks	Electricians
Musicians	Bookkeepers
Lawyers and judges	Miners
Truck and tractor drivers	Dentists
Waitresses	Real estate agents
Gas station attendants	Telephone operators
Plumbers	Nurses
Printers	Technical engineers
Doctors	Shoe repairmen
Beauticians, barbers	Shoe clerks
Painters	Teachers
Policemen	Photographers
Firemen	Pharmacists
Highway workers	Entertainers
Dressmakers	Editors and reporters
Librarians	Bakers
Bank clerks	Florists
Food clerks	Farmers
Stenos and typists	Plasterers
Cooks	Tailors, furriers
Cleaners, laundrymen	Mechanics, machinists
Newsboys	Hardware clerks

FIGURE 28

VARIOUS CATEGORIES OF THE SERVICE INDUSTRIES

NOTE: This figure is adapted from a presentation which appears in Miller, D. C. and Form, W. H. Industrial Sociology. 2nd Ed. New York: Harper and Row, 1964, p. 81.

contribution to the national economy.

Benjamin (Hilton, 1966) noted that performing a service and the manufacture of goods formed the basic aim of every company. A business and the individuals of a business feel more secure if they exist for the performance of a service first and the securing of profit second. Service in this case implies the activities of function for others as being a noteworthy contribution to society. Moore (1967), Moore (1965) and Kendrick (1961) noted that services can be broadly categorized to include personal services (hotels, restaurants), domestic service, professional service, commercial amusement and recreation, and non-profit membership organizations. Some of the services that have been established are significant in terms of wages and financial returns. The occupational scale includes service occupations from professional to unskilled. Each performs some significant function.

Stokes (1968) noted another kind of service which can range from a friendly smile to a high-cost service maintenance contract. Many things must be done in business to support business over and above the basic process of production. Stokes noted that services must be constantly performed if a business as a whole is to succeed. For example, a service station attendant who cleans the car windshield and checks the oil level is performing two kinds of services. Services such as these form a determining factor in

attracting and maintaining customers. Any major brand of gasoline is a good product, but the extra service performed will make the difference to the success of the business. Services of this type stem from the fact that competition is automatically built into any business enterprise.

Consumer Products

Modern craft and machine ages. The consumer products were simple requirements of basic food, clothing and shelter for the common people or the peasants. The goods, of which little was manufactured, were principally utilitarian. The nobility had a desire for goods that were beyond basic needs and emphasized the aesthetic or beauty of objects that were especially and exclusively made for particular individuals.

Power age. The power age saw the introduction of new technological advances that made possible increased goods that were no longer a concept of basic need but of desire. Williamson (Kranzberg and Pursell, 1967, Vol. I) noted that goods were mass produced and a wider variety of products were within reach of the general population. Process industries were particularly successful and food was being placed on store shelves in new packages and new forms that would increase the life before perishing. Some of the most significant advances included:

1. Meat packing--use of refrigerators and mobile refrigeration units.

2. Ready-to-wear items such as clothing--use of the textile industries and factory system.

3. Mass production of boots and shoes.

4. Assembly line products such as metal goods and automobiles.

5. Watches.

6. Bicycles.

The improvement of transportation, communication, and the methods of marketing and distribution made goods available to all segments of the population.

Atomic and cybernetics ages. These ages saw a more diversified form of goods, many that were classed as luxury items. The most significant product was that of drugs which aided the population in developing and maintaining better health practices and combatting diseases. Moore (1967) noted that physical products or goods influenced the following factors:

1. Household appliances.

2. Transportation and suburbanization.

3. Communication techniques and formal organizations.

4. Consumption of goods as status symbols.

5. Specialization and role conflict.

6. Leisure time activities.

7. Rational mate selection and marital adjustment.

Figure 29 shows the trade interchange between the United States and Japan of manufactured goods. Many of the

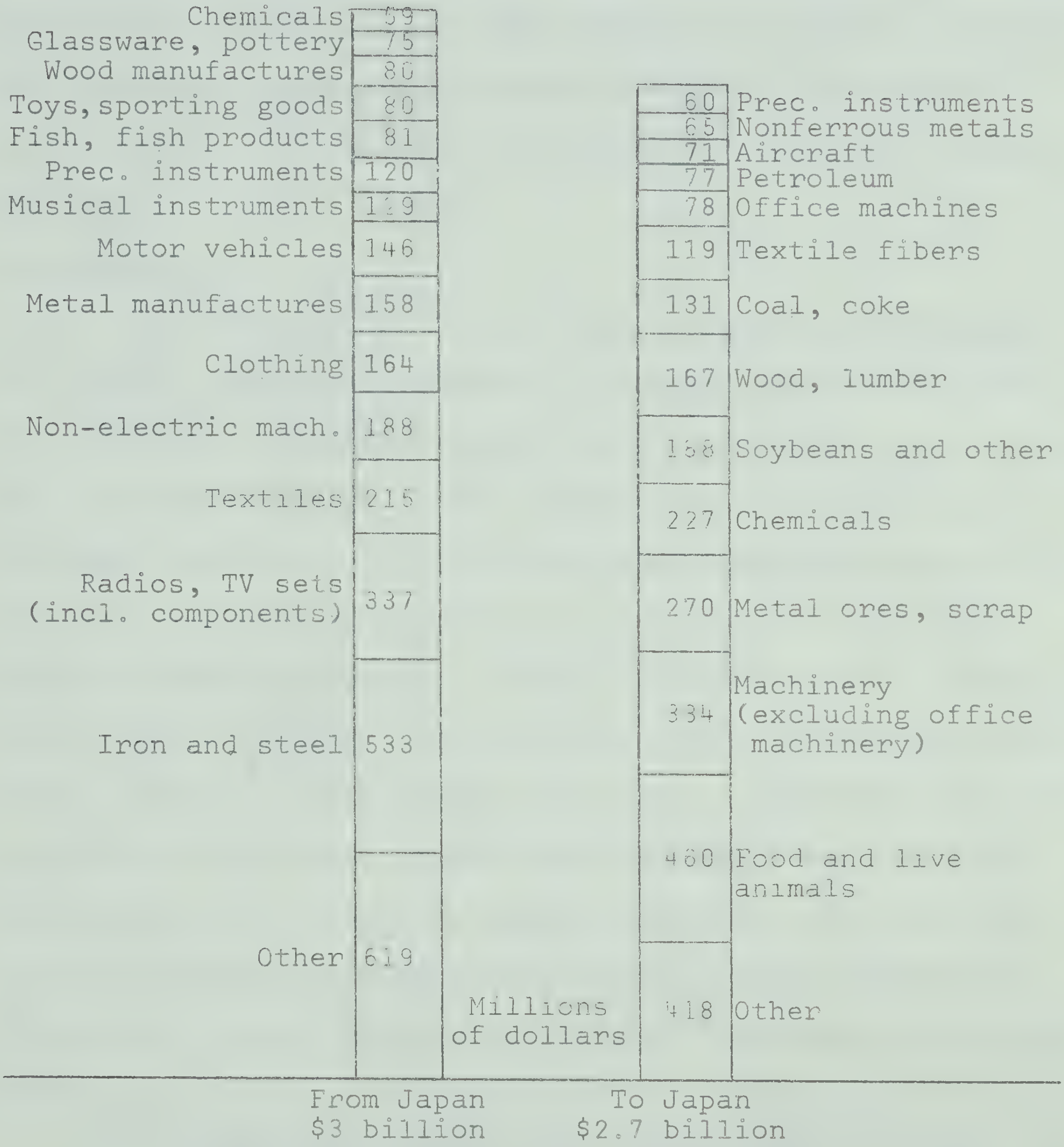


FIGURE 29

TRADE INTERCHANGE BETWEEN THE UNITED STATES AND JAPAN

Davenport, J. Japan's competitive edge. Fortune, 1968, 79, 93.

exports include materials that return to the United States as manufactured goods. United States still maintains superiority over Japan on items like aircraft and office equipment and computers because of superior methods of research and development. United States farm products are mostly shipped to Japan.

Environment

The four factors of environment as noted by Vincent and Mayers (1959) and Baranson (Kranzberg and Pursell, 1967, Vol. II) were physical, sociocultural, production techniques and production design. These factors were inherent in all the ages mentioned. Industrialism must develop because of increased demands by an expanding population. Before any industrialism can develop, certain features must be present. Figure 30 illustrates these features and the lines of influence. Basically this figure involves or summarizes the characteristics that have already been described and discussed. Technological development, labor, resources, consumers, and economy are all involved in this structure of environment. There is a two-way interaction between technology and environment:

1. Production systems and organization of labor, materials and equipment, and material and design of products.

2. The cost feasibility of production methods which depend upon the economic, sociocultural and physical aspects of the environment.

Technology serves as an instrument of environmental

ENVIRONMENT

Physical	Sociocultural
Resources Land form, climate, and other geographic characteristics Economy Size and nature of market demand Price, quality, and availability of production factors Transport, power, and other structures Availability of foreign exchange	Attitudes and aptitudes of labor and management Preferences and habits of consumers Social organization in support of productive activity Public policies and private goals Economic and social measures related to development Private costs and risks Legal codes

Production Techniques	Production Design
Factor combinations of labor, equipment, and materials Scale and organization of production	Costs Physical characteristics

FIGURE 30

INFLUENCE OF ENVIRONMENT UPON PRODUCT DESIGN AND PRODUCTION TECHNIQUES

Kranzberg, M., and Pursell, Carroll W. Technology in Western Civilization. New York: Oxford University Press, 1967, p. 518.

transformation. Some of the more significant factors that influence the environmental development of a country include economic environment, cultural factors, physical geography, public policies and private interests, scale and organization of production, product design, technological flexibility of a society, technological research capabilities, and government-industry cooperation. Environment, then, becomes the total setting in which a productive society functions.

Socialization

Socialization, for the purposes of this study, will be concerned with the impact of technology and industrialism upon the social systems or upon productive society.

Modern craft age. White (Kranzberg and Pursell, 1967, Vol. I) and Mumford (1934) noted that there was very little or no technological innovation during this age. For the general population the family group and the work surrounding it was most significant. Little of the outside world had influence on these people. For a small caste of people such as royalty and noblemen there was a creation of the highest forms of art, philosophy, literature, technics, science and religion. There were no attempts made to diffuse this type of culture down the social scale. Eventually this caste system was broken with the advent of Christianity in which every individual was treated accordingly and work became a point of salvation. Even the craft guilds were affected where the journeyman not only became qualified in

his work, but he also studied works from other cities to become proficient in the works of creation and beauty. The community was the center of social activity toward the end of this age. The concept of "classical antiquity" was slowly receding.

Machine age. This age was not much different. The most significant development occurred when there was a movement of people from the rural areas into the cities to work in the factories and shops that had been established. The beginnings of urbanization were becoming evident. This movement triggered a whole new concept of mass socialization.

Power age. The power age was introduced with the advent of the Industrial Revolution. Kranzberg and Pursell (1967, Vol. I), Mumford (1934) and Ashton (1964) noted that since the introduction of the Industrial Revolution and the new technologies came the threat to "human values." The more technology advanced, the more problems were created because of the inability to adapt to the change that was so influential. Man's fight against the unknown became more than just a struggle; it resulted in a whole new world. The process of technology could not be stopped nor the relationship ended; it had to be understood and directed toward noteworthy goals. There was an increase in the interaction of different societies and cultures as world travel slowly opened up. People became aware of the other

forms of technology and developments around them. The system of human values began to recognize the concept of industrialism and the influence of capitalism.

Lampard (Kranzberg and Pursell, 1967, Vol. I) noted that the economic conditions began to change and that the factors of growth, supply and demand for more goods was also increasing. Problems of employment and training began to show. Some of the basic problems that had to be solved were:

1. Change from an agrarian way of life to one of urbanization.
2. Socializing with more people.
3. Recruitment and training of workers for specialized tasks.
4. Adjustment of workers to the routine of factory work.
5. Adjustment to the problems of urbanization.
6. Formation of a new middle class of people.
7. Adaptation to the development of factors such as communication and transportation.
8. The trend toward rationalization and new concepts of education.
9. Adjustment caused by the increased level of living costs.

Atomic and cybernetics ages. These ages witnessed a new society evolving a more affluent type of society. John Diebold (1964) noted that despite the problems of automation such as training and retraining, dehumanization of work, and the replacement of workers by machines, the good side of

automation cannot be forgotten. Some points to be considered are:

1. Progress shown by technological change, which is desirable.

2. Development of shorter work week.

3. Unlimited demands for goods which will not cause mass unemployment.

4. Automation as the only way of maintaining the standard of living.

5. Automation, bringing about lower prices.

6. Automation as the key to national survival.

Donald N. Michael (1962) noted that cybernation has introduced a system that performs with speed and precision that is impossible for humans to duplicate. Cybernated systems of production have been built to detect and correct their own errors and to indicate to men the components that produce the errors. Cybernation has introduced such a vast change in social systems that much planning and understanding will be needed to not only preserve the present society but to also keep it in line with technological developments. Cybernation has resulted in more leisure time, and individuals will have to learn to adapt to the consequences. The greatest adjustment to cybernation will be the employment factor. Government control will be necessary to deal with retraining and placing workers back into some form of work. The demand for white collar workers will continue, but the situation of blue collar workers will be a problem until full adjustment

to cybernation is made. Education must begin early for the concepts of employment and leisure activities. Shifts in attitudes, values and behavior takes a long time; therefore, it is important that youth be made to realize the impact of cybernation. Michael (1962, p. 42) noted:

> As long as we choose to live in a world guided by science and technology we have no choice but to encourage the development of cybernation.

Galbraith (1958) noted that the need for employment has declined somewhat because the demand for goods has decreased. The markets have become saturated with a variety of goods. Men have demanded a shorter work period and as automation and computers are put into more production systems, less work will be required. Galbraith noted that because of these consequences a new class of people will emerge. They will not be wealthy but will possess more leisure time and work less as time goes on. The most significant qualification needed to enter this new class is education. This new class is increasing in size every year as more individuals go through the procedures of formal education and establish themselves in the echelons of the new class.

B. F. Skinner (Burke, 1966, p. 296) noted:

> If Western democracy does not lose sight of the aims of humanitarian action, it will welcome the almost fabulous support of its own science of man and will strengthen itself and play an important role in building a better world for everyone.

Skinner also noted that if science and technological advancement cannot be controlled, then progress will cease and the downfall of modern society will surely come.

Summary

The 23 characteristics of productive society were described within five ages or time periods:

1.	Modern craft age	1400-1800
2.	Machine age	1785-1880
3.	Power age	1870-1950
4.	Atomic age	1950-1965
5.	Cybernetics age	1964-present

Some characteristics were described within two ages because no significant points were found in the literature to permit separation into exclusive ages. Within each characteristic were factors basic to the description of each. They were:

1. The work function.
2. The industrial scene.
3. Significance of productivity.
4. Technology.

A summary chart in Appendix D displays an entire structure of the characteristics, by age, of productive society.

It is important to note that a study, somewhat similar to that reported here, was conducted by Roger Blomgren (1962). Blomgren's purpose was to formulate an "Understanding of American Industry Test." Before a test instrument could be constructed, some form of criteria had to be

established. These criteria were based on:

1. Selection of concepts that are most descriptive and are most relevant of industry-wide aspects of American industry.

2. Selection of sources that would give a clear and reliable picture of American industry. Some of his sources included industrial literature based on economics, engineering, history, management, psychology and sociology.

Through a carefully designed plan, Blomgren consulted various authors from the above-mentioned disciplines and solicited their assistance in suggesting authoritative literature that was within the scope of organization of American industry. On the basis of their suggested references Blomgren organized the information into certain topics.[9] His topics were:

1. Historical Development of American Industry. This topic included information on:

   a. Colonial Period to 1800--simple tools, machines, plants, home industry, crafts and simple materials.

   b. American Industrial Revolution 1800-1850--economic strength, machinery, skilled and unskilled labor, factory system, productivity, labor organization, labor class, training and education.

---

[9]No attempt is made here to completely describe Blomgren's classification methodology and results. Only a brief description is presented to give the reader an overview of his study and how it was organized to achieve his particular purpose. This writer's purpose in isolating Blomgren's study for specific review is that, while he used a methodology for describing industry that was different from that used in this study, Blomgren achieved a result similar to that reported here in arriving at an outline of characteristics.

c. Period of Mechanization 1350-1950--expansion of development, distribution, production systems, machines and tools, management, power and energy, economic structure, capital and some insight into the 1960's.

2. Labor Force and Organization in American Industry.

   a. Labor statistics on labor force, job preparation, technological advance, white and blue collar workers and occupations.

   b. Labor organization--unions, collective bargaining, skilled and unskilled workers, union management relations and general industrial relations.

3. Managing American Industry. This topic included information on planning and control, socialization, industrial organization, work organization, statistics, incentive plans, automation, mass production, safety and health in industry.

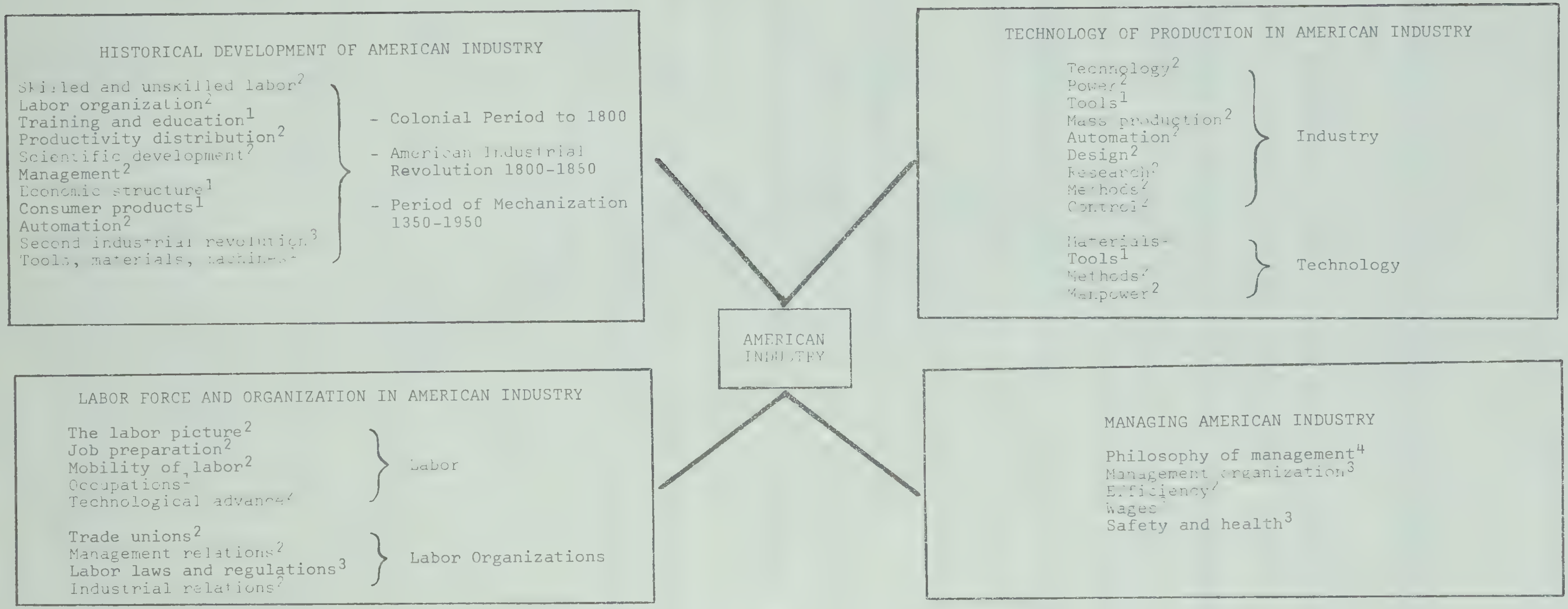
4. Technology of Production in American Industry.

   a. Definition of technology.

   b. Production techniques, including power, goods, services, tools, materials, methods, control, industrial production, parts interchangeability, factory, work flow, feedback, and research.

Figure 31 illustrates an outline of Blomgren's concept of American industry. The various concepts used in his study are similar to the characteristics used for this study.

Blomgren then organized the various concepts into an instrument that was used to test the understanding of American industry by various college students who were enrolled in the field of industrial arts education. Blomgren's thesis describes American industry and measures the



[1]Concepts used directly as characteristics.

[2]Concepts described under certain characteristics.

[3]Concepts mentioned but not completely described.

[4]Concepts not included.

FIGURE 31

AN OUTLINE DESCRIPTION OF AMERICAN INDUSTRY

NOTE: The above figure is compiled from Blomgren, R. D., An experimental study to determine the relative growth of a selected group of industrial arts education majors toward gaining an understanding of American industry. Unpublished Doctoral Dissertation, University of Illinois, 1962.

understanding of this concept when applied to college students.

Another study, done by the American Council of Industrial Arts Teacher Education (1968) and edited by Luetkemeyer, shows a historical perspective of industry. The primary purpose of this historical study lies in the review of three forms of industrial production which are (1) handicraft, (2) machine, and (3) automation and the interrelated economic and social systems. The historical study also assumes that the primary function of industry is the production of goods and services.

The historical approach illustrates another method used for describing industry to achieve a particular purpose, and the results show that some of the concepts discussed are similar to this study on productive society. An outline of the content used for the historical perspective is shown in Figure 32.

Origin of Man and His Dependency on Technology

- Stages of human development
- Technology

Handicraft Technology

- Manufacturing systems
- Economic systems
- Work concept

Industrial Revolution

- Interdependency of industries
- Environment
- Inventions

Machine Technology

- Tools
- Factory system
- Machines
- Mass production

Capitalism as an Economic System

- Capitalism

Role of Management

- Industrial management
- Levels of management
- Bureaucracy
- Formal organization
- Informal organization

Organized Labor

- Psychological need
- Organizational structure
- The industrial worker
- Unions

Automation and Cybernetics

- Automation } Definitions
- Cybernetics }

Applications

Effects

FIGURE 32

A HISTORICAL PERSPECTIVE OF INDUSTRY

Adapted from Luetkemeyer, J. F., Editor, A Historical Perspective of Industry, 17th Year Book, American Council of Industrial Arts Teacher Education (1968).

Chapter III

Teacher Opinionnaire Data Collection

Introduction

A purpose of the study reported here was to determine how industrial arts teachers in the Province of Alberta interpreted the concept of productive society. More specifically, the study sought to determine and compare scale values of the 23 characteristics of productive society (Appendix D) for a stratified random sample of industrial arts teachers in Alberta.

Chapter III sets forth the construction of the instrument used to measure how industrial arts teachers in the Province of Alberta interpret the concept of productive society.

Instrument Construction and Method of Analysis

Thurstone's Matched Pairs

The Instrument used in this study was based on Thurstone's classical matched pairs model. Thurstone (1926, 1927, 1931, 1951) noted that the method of paired comparisons or matched pairs can be validly applied for the measurement of social values, attitudes and opinions. Thurstone (1926) stated that this method of measurement can be easily established and an instrument constructed which would validly measure the interpretation of a particular set of concepts. For example, if a set of concepts are to be measured, they are listed in some form of order or at random. The concepts

are then arranged in pairs so that each one is paired with every other one. The total number of pairs of concepts is calculated by n(n-1)/2 where n is the number of concepts. Instructions are then issued to the subjects who will make the comparisons by indicating which of the concepts in each pair they feel is their choice according to some stated criterion. A table of scale values is then established in order that the researcher may determine how the subjects responded to a set of concepts. The scale values can be arranged in order of magnitude so that a ranking can be achieved.

Thurstone (1931) noted that when every stimulus serves as a standard, then it becomes a method of paired comparisons. Through various statistical manipulation, Thurstone has devised the "law of comparative judgment" where social attitudes and opinions can be successfully measured, lending meaning to a study using this method.

For the purposes of this study, 23 characteristics of productive society were listed as they appear in Chapter II (pages 25 and 26) and on the chart in Appendix D. Each characteristic was then paired with every other characteristic; for example:

The first part of the list of characteristics is:

Power and Energy

Natural Resources

Tools

Materials

Work Skills

Power and Energy was paired with Natural Resources, then with Tools, then with Materials, and so on in a like manner with each of the characteristics. This procedure paired Power and Energy with each characteristic.

Natural Resources was paired with Tools, then with Materials, and so on in a like manner with each of the characteristics. Each characteristic was paired with the other characteristics following the procedure explained above.[10] The 253 pairs were then randomly ordered and constituted part one of the opinionnaire on productive society.

An example of the question or criterion used by the respondents is:

Communication Information . . . . . | . . .
Environment . . . . | . . .

Natural Resources . . . . | . . .
Planning and Control . . . . | . .

Production Systems . . . . | . . .
Consumer Products . . . . | . . .

---

[10]The total number of pairs was n(n-1)/2 which was 23(23-1)/2 or 253 pairs.

The responses were to be made from each pair listed. See Appendix A for the complete list.

Part Two of the Opinionnaire

Part two of the opinionnaire was based on the descriptions of each characteristic of productive society, as outlined on the chart in Appendix D. According to this chart, each characteristic has a certain number of descriptions within the time periods outlined. For example, Power and Energy consists of five descriptions corresponding to the five time periods. Natural Resources has only four descriptions because the atomic age and the cybernetics age descriptions were combined to form a single description. The rest of the characteristics can be considered to have a certain number of descriptions depending upon how the time periods were combined, and in no case are there more than five descriptions for each characteristic. Each description was summarized into a single sentence statement. The stem, which consisted of the question or criterion the respondents used, was stated referring to a particular characteristic. The description statements were then listed below, from which a response was made. For example:

The Stem: When teaching the concept of Natural Resources as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes.

_____ is most important.

_____ is least important.

The response choices consisting of description statements:

A. Development of forests, land, minerals and water resources.
B. Enforcing the conservation movement and more extensive use of research.
C. The use of coal and iron.
D. Use of land for agriculture and forests for structure and fuel.

The stem remained the same with the exception of the characteristic. One stem was listed for each characteristic followed by the descriptive statements of that particular characteristic. The descriptive statements were randomly assigned so that the respondents would not have a clue to the time periods. No information was given to the respondents on the time periods and the manner in which the descriptions were assigned to the time periods. All descriptive statements were randomly arranged under the appropriate stem. The stems were also randomly arranged (Appendix A).

ASSUMPTION: No attempt was made to define the 23 characteristics of productive society for the respondents. It could be argued that with no definition being provided for each characteristic, each respondent might have a different connotation of that characteristic. It should be kept in mind, however, that the teacher training program for industrial arts teachers (while different at different universities) results in a commonality of interpretation for words such as materials, tools, services, etc., that would not be found if a group comprised of industrialists, mathematics teachers, etc., were sampled.

Summary

The sample of teachers responded to the opinionnaire in two ways:

1. They chose from pairs of characteristics and indicated which of the pair was most important in the teaching of industrial arts.

2. In the second part they indicated which description was most important and which description was least important when teaching industrial

arts. The teachers were given no knowledge of the ages in which the description appeared. The teachers responded to their choices in terms of teaching industrial arts in their own classrooms. Appendix A illustrates the first opinionnaire that was constructed and administered to a pilot study. Appendix B illustrates the final opinionnaire that was administered for this study.

Sample Selection

The opinionnaire was administered to 50 industrial arts teachers randomly selected from a stratified list of all full-time industrial arts teachers in the Province of Alberta. This list was comprised of all registered teachers who were teaching industrial arts full-time during the 1968-69 school year.

In an attempt to ensure proportional representation from all categories of industrial arts settings, the industrial arts teacher population was stratified into categories. Table I illustrates these categories.

Since Edmonton and Calgary are the largest school systems in the province, it was considered logical to separate them from the rest of the systems in order that a proportional representation may be achieved.[11] From a

---

[11]Populations of the various categories were based upon information obtained from the Alberta Provincial Planning Branch, Department of Municipal Affairs.

City--over 4,300
Town--209 - 4,300
Village--up to 1,200 (Continued)

TABLE I

CATEGORIZATION OF INDUSTRIAL ARTS TEACHERS

	Edmonton	Calgary	Cities[c]	Towns[d]	Villages[e]
Junior[f] High School	58[a] / [b] 6	52 / 6	22 / 3	107 / 11	[illegible] / [illegible]
Senior[g] High School	34 / 6	17 / 4	29 / 5	19 / 4	No Entry

[a] This number indicates the total number of industrial arts teachers in each cell; i.e., the population.

[b] This number indicates the number of teachers selected from the cell for this study; i.e., the sample.

[c] [d] [e] These categorizations were made according to data and statistics obtained from the Statistics Branch, Government of Alberta.

[f] Junior high school refers to grades 7, 8, and 9. In some cases grade 7 does not participate in the industrial arts program. This system of grade assignment is generally used in the Province of Alberta.

[g] Senior high school refers to grades 10, 11, and 12. This system is also used in the Province of Alberta.

total population of 484 industrial arts teachers, 50 were chosen for this study.

It must be noted that population alone does not determine the category of a city, town or village. The Municipalities Assistance Act has made the final categorization according to the methods of municipal assistance that each center receives. It was on the basis of this listing that the sample for this study was drawn.

Summary: The sample was based on two criteria:

1. The list of names of industrial arts teachers and where they teach was obtained from the Department of Education for the Province of Alberta.
2. The cities, towns, and villages were categorized according to the population figures listed by the Government of Alberta, Bureau of Statistics, 1968 tabulation.

Pilot Study

A pilot study was conducted to validate the instrument. Staff members of the Department of Industrial and Vocational Education at the University of Alberta and five teachers from the Edmonton Separate and Public School Systems participated in the pilot study. The teachers were not part of the sample selected for this study. The sample selection was made before the pilot study was conducted. As a result of the pilot study, the following changes were made:

1. Instructions were improved in both parts to aid in clarity of understanding of what was required.
2. The stems (criteria or question) for part one and part two were changed to aid in clarity of presentation of the opinionnaire.

Appendix A contains the opinionnaire used for the pilot study, and Appendix B contains the final form of the

opinionnaire mailed to the stratified random sample of industrial arts teachers.

Administration of the Instrument

Letter Requesting Cooperation

A letter was mailed to each teacher in the sample soliciting his assistance and cooperation in responding to the opinionnaire. A stamped post card was enclosed with the letter that provided a means whereby teachers could indicate their intentions if not wishing to participate in the study. Appendix C contains the letter and post card.

Opinionnaire Mailing

After a period of two weeks, the opinionnaire along with a covering letter (Appendix C) were mailed to each teacher of the sample. After a period of three weeks a follow-up letter (Appendix C) was mailed to the individuals who had not yet responded.

Telephone Calls

After a period of approximately a month and a half, telephone calls were made to the remaining teachers who had not yet replied. In certain cases second copies of opinionnaires had to be mailed because of loss in mail delivery.

Chapter IV illustrates the complete statistical analysis that was done for this study.

Chapter IV

Analysis of the Data

This chapter reports two different types of findings.[12] They are:

1. Findings related to the research problem.
2. Findings that relate information which was beyond the scope of the research problem.

Findings Related to the Research Problem

Instrument Returns

Of the 50 opinionnaires that were mailed to the industrial arts teacher sample, 50 or 100 per cent were returned. No opinionnaire had to be destroyed or disregarded in the final analysis of the data. Thirty opinionnaires were returned within three weeks of the initial mailing date and all opinionnaires were returned within approximately a month and a half.

Results of the Opinionnaire on Productive Society--Part I

Thurstone's Matched Pairs Model, Condition C[13] was used to analyze the data in Part I. Condition C was employed to lend meaning to the data collected. The sources of error

---

[12]It is believed that by a study of each of these types of findings under separate headings, the reader will more clearly understand the instrument and the results of this study.

[13]Since there was a source of error for Part I, Condition C was employed where there was an interpolation performed for missing data. Adjoining matrix columns were used for this calculation.

that resulted in this part of the instrument were due to two factors:

1. An error was made in the organization of pairing the concepts. Some pairs of concepts were not included in the scheme, while some pairs were repeated more than once.

2. Error also resulted when some concepts did not receive a response from the teachers.

A brief description of the method of arriving at values for the various characteristics according to the respondents' choices is based upon the proportion matrix as illustrated in Table II. This matrix illustrates the number of times that one characteristic was chosen in preference to another characteristic. For example, the characteristic of industrial organization was preferred 35 times over the characteristic of consumer products. Further examination of Table II illustrates that the characteristics along the top row or in row K are preferred a certain number of times in relation to the characteristics in column J. This relation then forms a proportion which illustrates how the respondents' choices were proportioned out in terms of the 23 characteristics of productive society. The matrix in Table II is based on the entire sample of respondents. Similar matrices were derived for each of the groups as shown in Table I, Chapter III. The groups were organized as follows:

Total Group (Entire Sample of 50)

$\left.\begin{array}{l}\text{Junior High School}\\ \text{Senior High School}\\ \text{Edmonton, Calgary}\\ \text{City, Town, Village}\end{array}\right\}$ Four Basic Groups

TABLE 11

PROPORTION MATRIX*

	Power & Energy	Natural Resources	Tools	Materials	Work Skills	Inventions & Development	Scientific Development	Production Systems	Processes	Transportation	Communication Information	Labor	Management & Personnel	Economic Structure	Industrial Organization	Marketing	Planning & Control	Training & Education	Occupations	Services	Consumer Products	Environment	Socialization
Power & Energy	0	25	[illegible]	[illegible]	[illegible]	4	28	33	35	[illegible]	[illegible]	19	15	[illegible]	28	[illegible]	5	29	22	18	19	14	17
Natural Resources	25	0	27	[illegible]	23	[illegible]	40	38	33	13	[illegible]	16	[illegible]	[illegible]	29	[illegible]	4	43	31	16	[illegible]	[illegible]	18
Tools	31	23	0	[illegible]	23	[illegible]	31	0	41	18	[illegible]	19	26	[illegible]	29	[illegible]	[illegible]	44	36	22	23	24	22
Materials	17	6	16	[illegible]	14	[illegible]	[illegible]	[illegible]	[illegible]	8	[illegible]	7	21	[illegible]	24	[illegible]	[illegible]	28	23	12	[illegible]	[illegible]	[illegible]
Work Skills	31	27	27	[illegible]	0	[illegible]	[illegible]	[illegible]	34	21	[illegible]	14	25	21	30	[illegible]	[illegible]	[illegible]	35	25	0	21	[illegible]
Inventions & Development	26	10	16	[illegible]	20	[illegible]	[illegible]	[illegible]	26	7	[illegible]	13	13	11	20	[illegible]	[illegible]	29	26	10	[illegible]	11	14
Scientific Development	22	[illegible]	19	[illegible]	22	[illegible]	[illegible]	[illegible]	25	6	[illegible]	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	37	0	0	[illegible]	12	13
Production Systems	[illegible]	12	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29	10	[illegible]	8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29	20	10	[illegible]	13	17
Processes	[illegible]	17	9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	9	[illegible]	7	[illegible]	[illegible]	[illegible]	[illegible]	19	27	20	16	[illegible]	[illegible]	[illegible]
Transportation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	41	0	[illegible]	21	[illegible]	[illegible]	[illegible]	[illegible]	40	39	36	30	[illegible]	32	24
Communication Information	[illegible]	[illegible]	7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	32	14	[illegible]	12	[illegible]	[illegible]	[illegible]	[illegible]	37	40	28	13	[illegible]	14	16
Labor	[illegible]	[illegible]	[illegible]	43	36	[illegible]	[illegible]	[illegible]	43	29	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	45	39	32	31	[illegible]	[illegible]
Management & Personnel	[illegible]	[illegible]	[illegible]	29	25	[illegible]	[illegible]	[illegible]	36	16	[illegible]	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	36	30	16	16	15	15
Economic Structure	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	36	16	[illegible]	21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	45	35	22	27	20	25
Industrial Organization	[illegible]	21	21	26	[illegible]	[illegible]	[illegible]	31	33	[illegible]	[illegible]	12	[illegible]	[illegible]	0	7	[illegible]	28	24	15	15	17	14
Marketing	[illegible]	36	30	40	[illegible]	[illegible]	[illegible]	[illegible]	44	[illegible]	40	29	[illegible]	[illegible]	43	0	[illegible]	[illegible]	[illegible]	[illegible]	28	26	32
Planning & Control	25	16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31	[illegible]	13	14	[illegible]	[illegible]	25	8	[illegible]	[illegible]	[illegible]	10	17	17	12
Training & Education	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	23	[illegible]	10	5	[illegible]	[illegible]	22	4	[illegible]	[illegible]	[illegible]	5	13	8	11
Occupations	28	19	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30	[illegible]	22	11	[illegible]	[illegible]	26	12	32	[illegible]	[illegible]	[illegible]	18	14	15
Services	32	34	28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	34	[illegible]	37	18	[illegible]	[illegible]	35	11	40	[illegible]	40	[illegible]	25	14	17
Consumer Products	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	41	[illegible]	30	19	[illegible]	[illegible]	35	22	33	37	32	25	0	19	18
Environment	36	32	24	32	29	[illegible]	[illegible]	[illegible]	37	[illegible]	36	23	[illegible]	[illegible]	33	24	[illegible]	42	36	36	31	0	26
Socialization	[illegible]	32	28	33	27	36	[illegible]	[illegible]	36	[illegible]	34	33	[illegible]	[illegible]	36	[illegible]	38	39	35	33	32	24	0

*Number of times Stimulus K is greater than J.

Calgary Junior High School
Calgary Senior High School
Edmonton Junior High School
Edmonton Senior High School
City Junior High School
City Senior High School
Town Junior High School
Town Senior High School
Village Junior High School

This type of organization constituted a total of 14 different groups including one group which comprised of the total sample.[14]

It was on the basis of the proportion matrix (Table II) that standardized scale values were derived for each of the characteristics in each of the groups comprising the sample and identified in Table III.[15] These standardized scale values, which have a mean of zero and a standard deviation of one, were used to assign a rank order to each characteristic. The numbers in parentheses in Table III illustrate the rank order in which the characteristics were emphasized by the teachers, beginning with (1), the most important, to (23), the least important characteristic. The standardized scale values range from negative to positive quantities, and it was on this basis that a rank order was

---

[14]It should be noted that each of these groups are mutually exclusive and that the numbers in each group are simply a result of the method used to divide the total sample into various groups.

[15]Each proportion matrix is not shown for each group. Only the results of the calculations used were shown in the form of standardized scale values (Table III).

TABLE III

STANDARD SCORES FOR EACH CHARACTERISTIC*

*The numbers in brackets indicate the rank order of each characteristic from most important to least important.

	All Student Total Sample	Junior High School	Senior High School	Edmonton, Calgary	City, Town, Village	Town Junior High School	Calgary Junior High School	Calgary Senior High School	City Junior High School	City Senior High School	Village Junior High School	Edmonton Senior High School	Town Senior High School	Edmonton Junior High School
Power & Energy	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.868(21)	[illegible]	0.462(10)	-0.131(17)	-0.728(17)	[illegible]	[illegible]	[illegible]	[illegible]
Natural Resources	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.002(11)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tools	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.225(9)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.778(4)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Inventions & Developments	-0.16(14)	0.094(7)	-0.45(16)	0.203(18)	-0.441(19)	[illegible]	[illegible]	0.639(6)	-0.884(19)	-1.045(19)	-0.166(13)	-0.498(16)	[illegible]	[illegible]
[illegible]	2.98(1)	1.803(3)	1.55(1)	0.243(1)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.121(16)	1.308(3)	1.513(3)	0.837(4)	0.807(4)	0.526(8)	0.95(4)	0.416(9)	-1.343(21)	-0.581(17)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.766(2)	0.149(8)	-1.233(22)	-0.06(12)	1.917(2)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-1.602(22)	-0.404(15)	-1.822(22)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Communication Information	-0.011(12)	-2.486(23)	-0.1(13)	0.173(22)	-0.099(15)	-1.081(22)	-2.067(23)	-0.676(18)	3.003(1)	0.526(9)	-2.377(23)	0.99(3)	0.368(7)	-0.3(14)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Management & Personnel	0.042(11)	2.221(1)	-1.457(20)	0.213(14)	0.210(8)	-0.628(19)	-1.085(20)	-1.066(21)	0.217(10)	-0.143(11)	-1.13(21)	-0.244(13)	1.972(2)	-0.588(18)
Economic Structure	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.639(16)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Industrial Organization	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Marketing	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.131(11)	-1.13(21)	0.313(7)	0.378(10)	0.169(9)	-1.495(22)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-1.153(21)	-0.383(14)	-0.723(19)	0.971(4)	-0.06(13)	0.485(8)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.131(12)	0.618(7)	2.216(1)	2.101(1)	-0.121(14)	0.067(10)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.302(7)	0.674(6)	0.943(5)	-1.035(17)	-0.724(20)	2.22(1)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Socialization	-0.446(18)	-0.167(12)	1.676(4)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

assigned. For example, from Table III, column headed "All Groups," the most important characteristic, which was Scientific Development, had a scale value of 2.98. The least important characteristic was Occupations, with a scale value of -2.418. Using the scale values as a basis for rank ordering the characteristics, the total sample of teachers emphasized the 23 characteristics in the following manner (most important to least important):

1. Scientific Development
2. Training and Education
3. Tools
4. Environment
5. Labor
6. Planning and Control
7. Consumer Products
8. Transportation
9. Processes
10. Production Systems
11. Management and Personnel
12. Communication Information
13. Services
14. Inventions and Developments
15. Work Skills
16. Materials
17. Industrial Organization
18. Socialization

19. Natural Resources

20. Marketing

21. Power and Energy

22. Economic Structure

23. Occupations

It is interesting to note that the characteristics with high positive scores (+1 or more) were Scientific Development, Training and Education, and Tools. This means that teachers placed much emphasis on these characteristics. The characteristics with least emphasis had low negative scores (-1 or less). They were Economic Structure and Occupations.

The order of these characteristics for the total group was used to show a more complete relationship as illustrated in Figures 33, 34, 35 and 36.

Results of the Opinionnaire on Productive Society--Part II

Part II of the instrument required the respondents to make two basic decisions:

1. To choose which description of a particular characteristic was, in their opinions, most important.

2. To choose which description of a particular characteristic was, in their opinions, least important.

Each characteristic possessed a series of descriptions based on particular periods of time.

For example, question number one refers five descriptions to the characteristic of Natural Resources. Each of

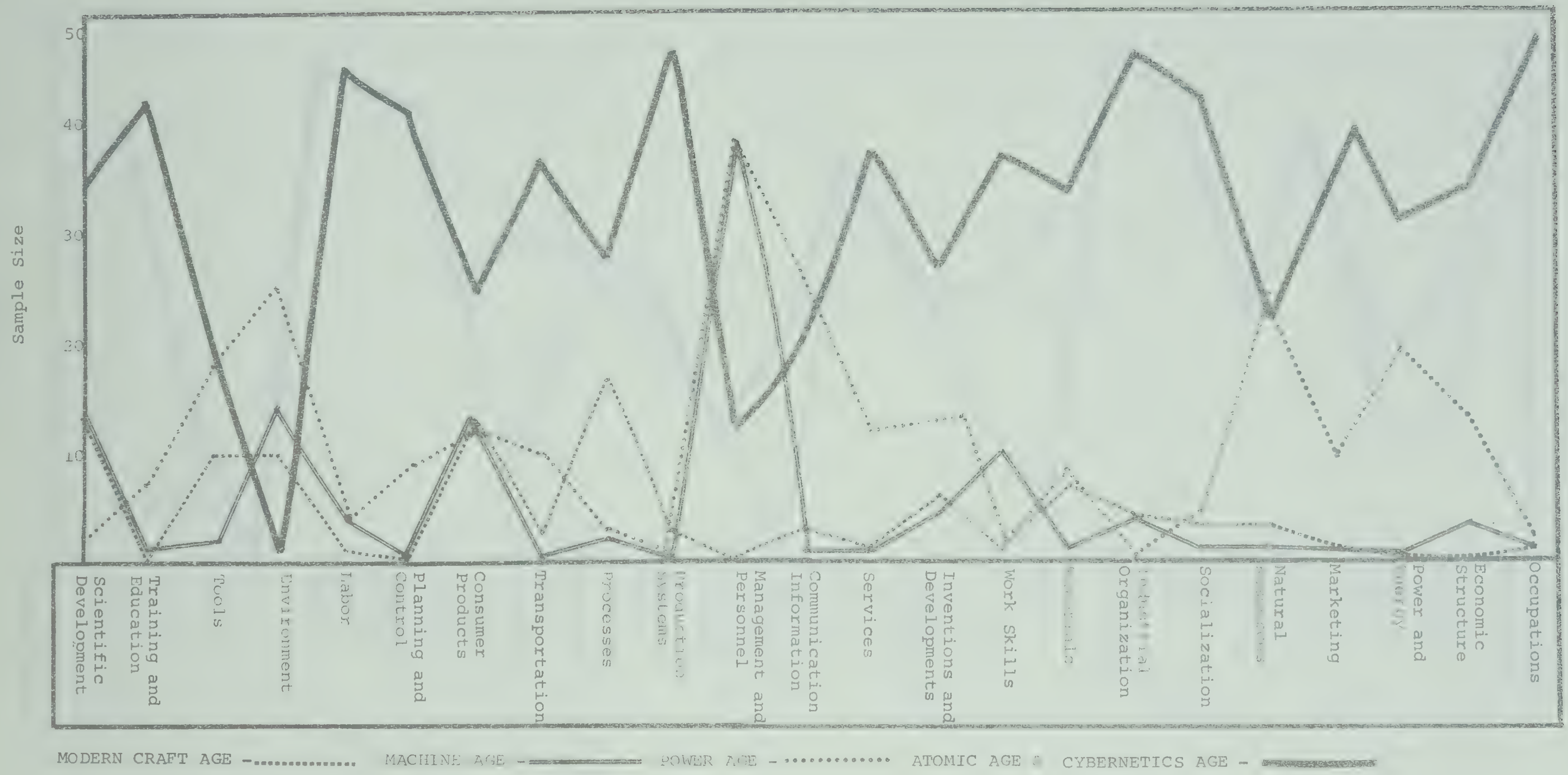


FIGURE 33

RELATIONSHIP BETWEEN THE CHARACTERISTICS AND THE VARIOUS TIME PERIODS FOR THE MOST IMPORTANT DESCRIPTIONS.
(Atomic and Cybernetics Ages are combined.)

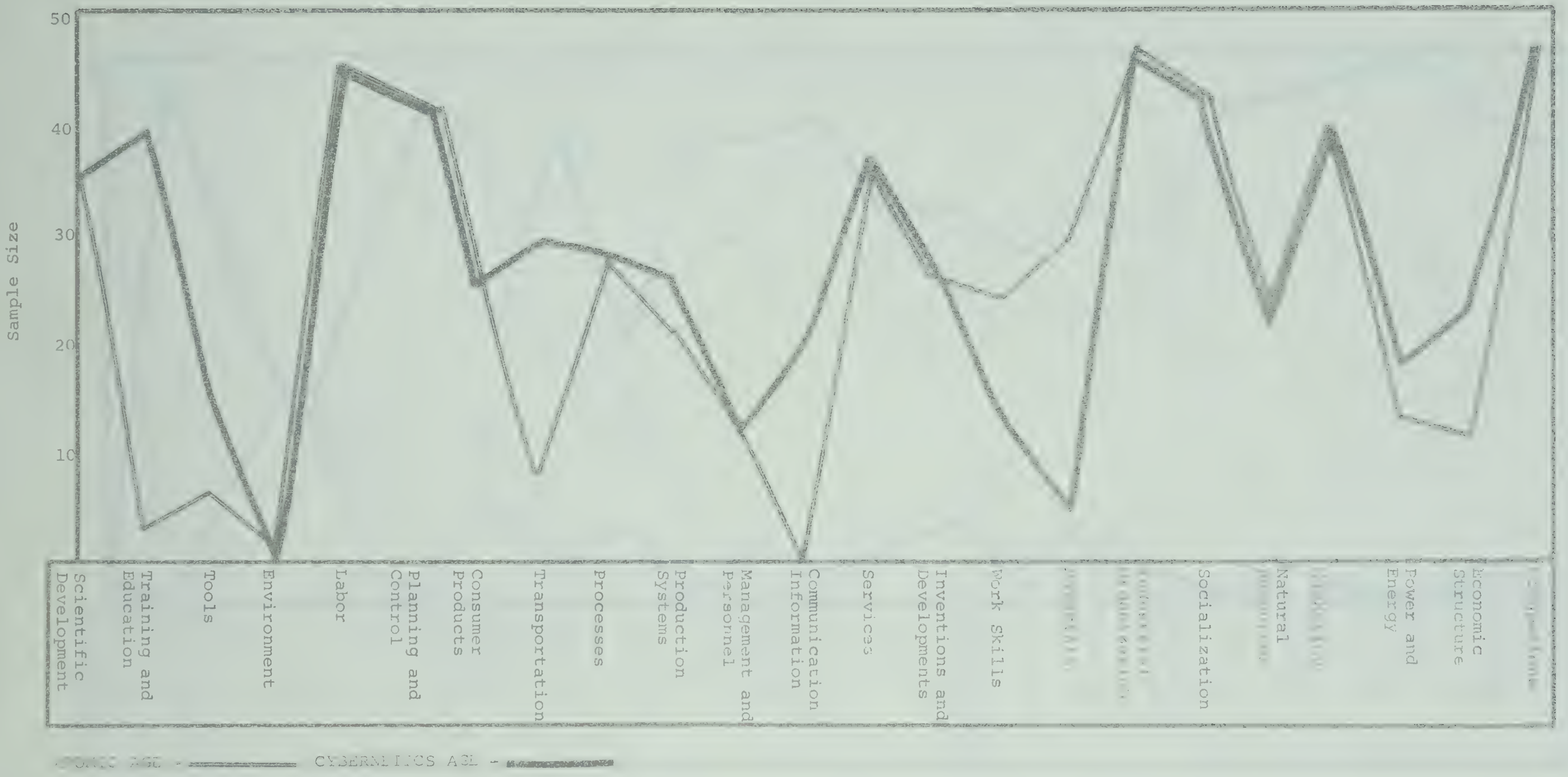


FIGURE 34

RELATIONSHIP BETWEEN THE CHARACTERISTICS AND THE VARIOUS TIME PERIODS FOR THE MOST IMPORTANT DESCRIPTIONS.
(Atomic Age and Cybernetics Age)

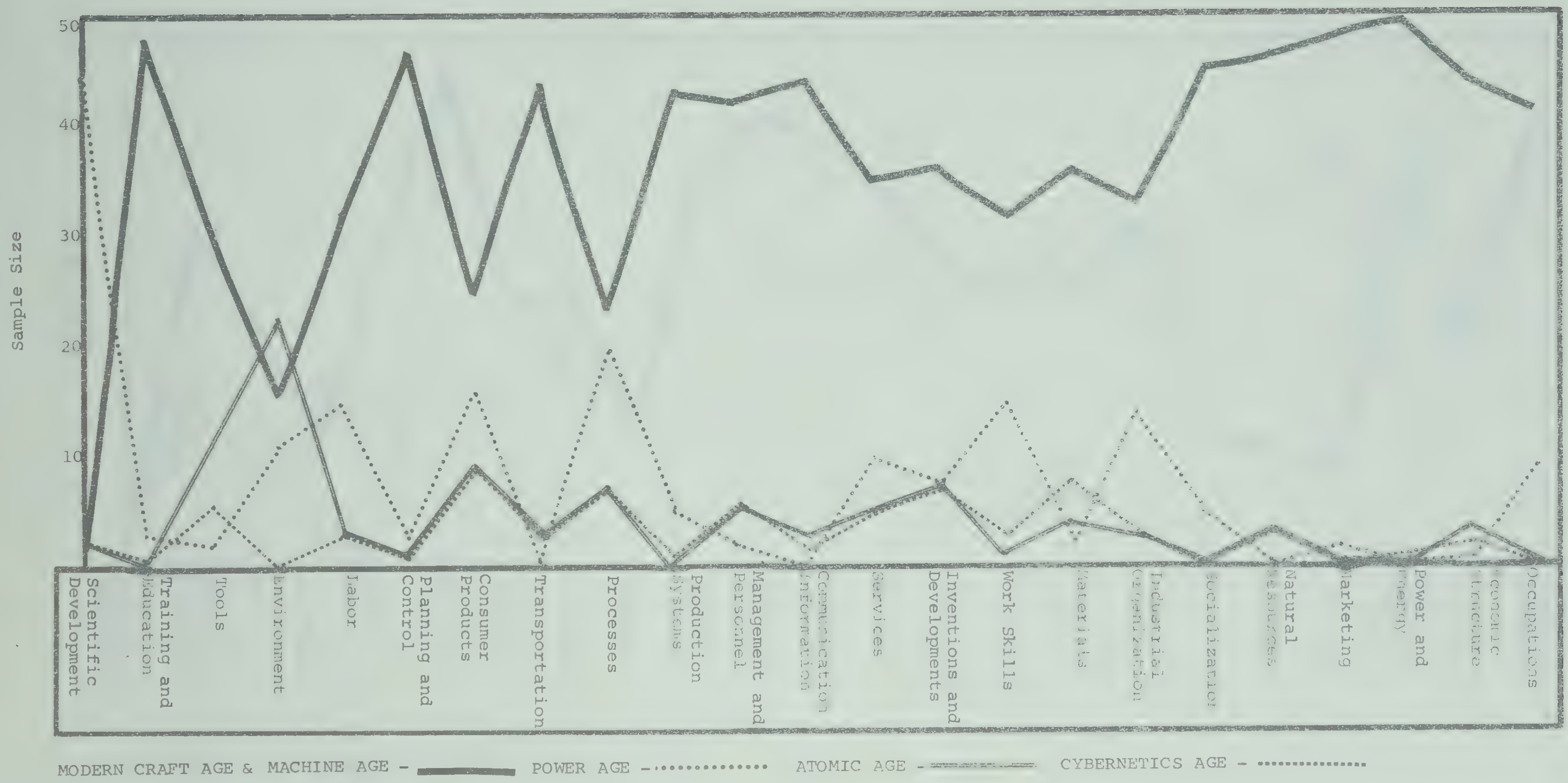


FIGURE 35

RELATIONSHIP BETWEEN THE CHARACTERISTICS AND THE VARIOUS TIME PERIODS FOR THE LEAST IMPORTANT DESCRIPTIONS.
(Modern Craft and Machine Ages are combined.)

FIGURE 36

RELATIONSHIP BETWEEN THE CHARACTERISTICS AND THE VARIOUS TIME PERIODS FOR THE LEAST IMPORTANT DESCRIPTIONS.
(Modern Craft Age and Machine Age)

these descriptions falls in a certain age group as shown on the chart in Appendix D. The first description, development of forests, land, minerals and water resources, refers to the power age. The second description, enforcing the conservation movement and more extensive use of research, refers to the atomic and cybernetics ages. The third description, the use of coal and iron, refers to the machine age. The fourth description, use of land for agriculture and forests for structure and fuel, refers to the modern craft age.[16]

Table IV illustrates a frequency count of the manner in which the respondents chose the descriptions to be most important. For example, the characteristic of natural resources shows that three respondents chose the modern craft age as most important, one chose the machine age, twenty-four chose the power age, and twenty-two chose the atomic and cybernetics ages as being most important.

The characteristics on the left-hand column are not arranged according to any criteria other than the order in which they appear in the questions in Part II of the instrument.

Table V illustrates how the respondents chose the age levels for the least important descriptions for the charac-

---

[16]It should be remembered that the respondents were not aware of the fact that each description referred to a particular period of time.

TABLE IV

FREQUENCY OF RESPONDENTS' CHOICE FOR THE MOST IMPORTANT DESCRIPTION (ALL GROUPS)*

*n = 50	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	3		1		24		22	
Management & Personnel	0			38			12	
Communication Information	3		1		26	0		20
Materials	7		1		8	29		5
Socialization	3		1		4	0	42	
Production Systems	3		0		0	21		26
Work Skills	1		10		2	24		13
Training & Education	0		1		7	3		39
Marketing	1		1		9		39	
Labor	1			4			45	
Power & Energy	0		0		19	13		18
Inventions & Developments	6		4		13		27	
Industrial Organization		4			0		46	
Planning & Control		0			9		41	
Tools	10		2		18	6		14
Processes	17		2		3		28	
Scientific Development		13			2		35	
Consumer Products		13			12		25	
Occupations		1			2		47	
Transportation	3		0		10	8		29
Services		1			12		37	
Environment	10		14		25	1		
Economic Structure	0		3		13	11		23

TABLE V

FREQUENCY OF RESPONDENTS' CHOICE FOR THE LEAST IMPORTANT DESCRIPTION (ALL GROUPS)*

*n = 50	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	11		35		1		3	
Management & Personnel	42			[illegible]			[illegible]	
Communication Information	41		4		[illegible]	[illegible]		[illegible]
Materials	27		[illegible]		[illegible]	[illegible]		[illegible]
Socialization	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	
Production System	[illegible]		[illegible]		[illegible]	[illegible]		[illegible]
Work Skills	[illegible]		[illegible]		14	[illegible]		[illegible]
Training & Education	[illegible]		[illegible]		[illegible]	[illegible]		[illegible]
Marketing	[illegible]		[illegible]		[illegible]		[illegible]	
Labor	[illegible]			15			[illegible]	
Power & Energy	[illegible]		[illegible]		[illegible]	[illegible]		[illegible]
Inventions & Developments	[illegible]		9		7		7	
Industrial Organization		[illegible]			[illegible]		[illegible]	
Planning & Control		[illegible]			[illegible]		[illegible]	
Tools	[illegible]		[illegible]		[illegible]	11		[illegible]
Processes	14		9		[illegible]		[illegible]	
Scientific Development		[illegible]			45		[illegible]	
Consumer Products		25			16		[illegible]	
Occupations		41			9		[illegible]	
Transportation	26		18		[illegible]	[illegible]		3
Services		35			10		5	
Environment	12		4		11	[illegible]		
Economic Structure	20		24		1	[illegible]		2

teristics. Any blocked-out sections in Tables IV and V indicate that no response was possible for that particular age. The information contained in Tables IV and V was used to show a more complete relationship as illustrated in Figures 33, 34, 35 and 36.

<u>Findings Related to the Research Problem</u>

The results of Part I and Part II of the instrument were combined to illustrate a more meaningful relationship between the two sets of data. Figure 33 illustrates the overall relationship between the characteristics and the way in which the respondents chose the various ages to be most important for those particular characteristics. The characteristics are arranged in rank order from most important to least important. The extreme left-hand column shows the number of respondents. For example, the characteristic of scientific development was emphasized most by the respondents and the descriptions considered to be most important were contained in the atomic and cybernetics ages. Figure 33 illustrates the atomic and cybernetics ages combined. This was done for two reasons:

1. It showed a clearer picture of the overall relationship.

2. A close examination of Table IV will show that there are several entries under the column headed "Atomic and Cybernetics Ages." It seemed logical to show this combination in Figure 33. The same holds true for Figure 35 wherein the modern craft and machine ages were combined because of combined cells as shown in Table V.

Figure 34 illustrates essentially the same kind of relationship with only the atomic and cybernetics ages as they appeared before being combined.

Figures 35 and 36 were structured in the same manner but illustrate the relationship between the characteristics and the descriptions of the ages that were least important for the particular characteristics. The characteristics were also arranged from most important to least important.

It should be noted that the line graphs do not illustrate a relationship between the characteristics themselves but show the frequency of responses for each, by characteristic.

Summary

No criteria were set down for a method of ordering the characteristics of productive society. Analysis of the responses illustrated the way in which the industrial arts teachers placed emphasis on the various concepts. The characteristics were rank ordered from most important to least important according to the standardized scale values. The graphs in Figures 33, 34, 35 and 36 illustrate a somewhat random pattern with respect to the emphasis of the different age levels. The standardized scale values in Table III also illustrate the degree of emphasis that was placed upon the various characteristics.

Other Findings

Some other findings that were beyond the scope of the

problem were revealed as the data were being analyzed. These findings relate to the four basic groups of teachers that were organized from the sample as illustrated in Table I, Chapter III. These groups were:

1. Junior High School Teachers
2. Senior High School Teachers
3. Edmonton, Calgary Teachers
4. City, Town, Village Teachers

Table III illustrates the standardized scale values for all the groups of teachers. Only the four basic groups will be dealt with. The characteristics were emphasized in a different way for each of the four basic groups of teachers. Figure 37 illustrates the characteristics that were assigned as being most important (scale value of +1 or more) and the characteristics that were considered to be least important (scale value of -1 or less). Only the extreme ends of the scale are shown in Figure 37. Table III illustrates a more complete rank order.

A frequency count for the method of response to the various age levels for the different characteristics is illustrated in Tables VI, VII, VIII, IX, X, XI, XII and XIII. These tables illustrate responses for the most important and least important descriptions for the four basic groups.

Table XIV illustrates the degree of relationship between the various groups. This table is better known as a correlation matrix where the value of a relationship between

[illegible]

Group	Most Important*	Least Important**
Junior High School	Management & Personnel Consumer Products Training & Education	Communication Information Economic Structure
Senior High School	Scientific Development Tools	Economic Structure Industrial Organization Natural Resources Management & Personnel
Edmonton, Calgary	No extreme positive values	Environment
City, Town, Village	Scientific Development Occupations	Industrial Organization Economic Structure

FIGURE 37

THE RELATIVE IMPORTANCE OF THE VARIOUS CHARACTERISTICS FOR THE FOUR BASIC GROUPS OF TEACHERS

*Based on a standardized scale value of +1 or more.

**Based on a standardized scale value of -1 or less.

two groups does not exceed ± 1. For example, the senior high school group shows a correlation value of .277 against the junior high school group. In other words, the degree of relatedness or the similarity in the way the teachers of these two groups responded to the various characteristics

TABLE VI

FREQUENCY OF RESPONDENTS' CHOICE TO THE LEAST IMPORTANT DESCRIPTION (JUNIOR HIGH SCHOOL)*

*n = 31	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	5		23		1		2	
Management & Personnel	25			1			5	
Communication Information	28		2		0	0		1
Materials	17		7		3	0		4
Socialization	8		21		2	0	0	
Production Systems	26		3		2	0		0
Work Skills	20		3		5	0		3
Training & Education	19		10		1	0		1
Marketing	4		15		1		0	
Labor	20			10			1	
Power & Energy	24		6		0	0		1
Inventions & Developments	17		7		3		4	
Industrial Organization		22			7		2	
Planning & Control		29			1		1	
Tools	14		6		9			2
Processes	9		3		16		3	
Scientific Development		2			28		1	
Consumer Products		17			8		5	
Occupations		28			3		0	
Transportation	17		10		2	2		2
Services		23			5		3	
Environment	8		2		6	5		
Economic Structure	14		15		0	0		2

TABLE VII

FREQUENCY OF RESPONDENTS' CHOICE FOR THE MOST IMPORTANT DESCRIPTION (JUNIOR HIGH SCHOOL)*

*n = 31	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	2		1		11		17	
Management & Personnel	0			25			6	
Communication Information	1		0		17	0		13
Materials	4		0		5	18		4
Socialization	[illegible]		0		1	[illegible]	[illegible]	
Production Systems	2		0		3	10		16
Work Skills	1		5		2	14		9
Training & Education	0		1		3	1		26
Marketing	1		1		5		24	
Labor	1			2			18	
Power & Energy	0		0		12	7		12
Inventions & Developments	2		2		9		18	
Industrial Organization		3			0		28	
Planning & Control		0			6		25	
Tools	7		0		12	3		9
Processes	10		1		1		19	
Scientific Development		6			2		23	
Consumer Products		5			9		17	
Occupations		1			1		29	
Transportation	3		0		4	5		18
Services		1			8		22	
Environment	8		7		15	1		
Economic Structure	0		1		10	10		10

TABLE VIII

FREQUENCY OF RESPONDENTS' CHOICE FOR THE MOST IMPORTANT DESCRIPTION (SENIOR HIGH SCHOOL)*

*n = 19	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	1		0		8		10	
Management & Personnel	0			13			5	
Communication Information	2		1		9	0		7
Materials	3		1		3	11		1
Socialization	1		1		2	0	15	
Production Systems	1		0		0	8		10
Work Skills	0		5		0	10		4
Training & Education	0		0		4	2		13
Marketing	0		0		4		15	
Labor	0			2			17	
Power & Energy	0		0		7	6		6
Inventions & Developments	4		2		4		9	
Industrial Organization		1			0		18	
Planning & Control		0			3		16	
Tools	3		2		6	3		5
Processes	7		1		2		9	
Scientific Development		7			0		12	
Consumer Products		8			3		8	
Occupations		0			1		18	
Transportation	0		0		6	2		11
Services		0			4		15	
Environment	2		7		10	0		
Economic Structure	0		2		3	1		13

TABLE [illegible]

FREQUENCY OF RESPONDENTS' CHOICE FOR THE LEAST IMPORTANT DESCRIPTION (SENIOR HIGH SCHOOL)*

*n = 19	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	[illegible]		[illegible]		[illegible]		[illegible]	
Management & Personnel	17			[illegible]			[illegible]	
Communication Information	13		[illegible]		[illegible]	[illegible]		[illegible]
Materials	10		[illegible]		[illegible]	1		[illegible]
Socialization	4		[illegible]		[illegible]	0	[illegible]	
Production Systems	[illegible]		[illegible]		[illegible]	[illegible]		[illegible]
Work Skills	[illegible]		1		9	1		0
Training & Education	[illegible]		6		[illegible]	0		0
Marketing	[illegible]		13		1		[illegible]	
Labor	[illegible]			5			[illegible]	
Power & Energy	[illegible]		4		0	0		[illegible]
Inventions & Developments	10		[illegible]		14		[illegible]	
Industrial Organization		[illegible]			7		1	
Planning & Control		13			[illegible]		0	
Tools	8		3		2	[illegible]		4
Processes	5		5		4		[illegible]	
Scientific Development		0			17		[illegible]	
Consumer Products		[illegible]			8		4	
Occupations		[illegible]			6		[illegible]	
Transportation	9		8		0	1		[illegible]
Services		[illegible]			5		[illegible]	
Environment	4		2		5	8		
Economic Structure	6		9		1	[illegible]		0

TABLE X

FREQUENCY OF RESPONDENTS' CHOICE FOR THE MOST IMPORTANT DESCRIPTION (EDMONTON-CALGARY)*

*n = 22	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	1		0		12		9	
Management & Personnel	0			18			4	
Communication Information	3		1		11	0		7
Materials	3		0		4	13		2
Socialization	2		1		2	0	17	
Production Systems	0		0		0	10		12
Work Skills	1		4		1	13		3
Training & Education	0		0		4	1		17
Marketing	1		0		3		18	
Labor	1			2			19	
Power & Energy	0		0		8	8		6
Inventions & Developments	3		1		4		14	
Industrial Organization		2			0		20	
Planning & Control		0			3		19	
Tools	4		2		6	4		6
Processes	5		1		1		15	
Scientific Development		4			1		17	
Consumer Products		9			2		11	
Occupations		1			1		20	
Transportation	2		0		4	2		14
Services		0			4		18	
Environment	5		8		9	0		
Economic Structure	0		1		6	3		12

TABLE XI

FREQUENCY OF RESPONDENTS' CHOICE FOR THE LEAST IMPORTANT DESCRIPTION (EDMONTON-CALGARY)*

[illegible]	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	6		[illegible]		1		0	
Management & Personnel	[illegible]			0			1	
Communication Information	[illegible]		[illegible]		[illegible]	[illegible]		1
Materials	[illegible]		[illegible]		2	1		[illegible]
Socialization	6		[illegible]		[illegible]	[illegible]	[illegible]	
Production Systems	[illegible]		[illegible]		[illegible]	[illegible]		1
Work Skills	10		[illegible]		[illegible]	1		1
Training & Education	15		[illegible]		9	0		0
Marketing	[illegible]		[illegible]		[illegible]		[illegible]	
Labor	13			8			0	
Power & Energy	16		6		0	0		0
Inventions & Developments	12		[illegible]		4		3	
Industrial Organization		[illegible]			9		1	
Planning & Control		[illegible]			0		0	
Tools	9		3		1	5		4
Processes	7		4		9		2	
Scientific Development		1			20		1	
Consumer Products		[illegible]			11		4	
Occupations		18			4		[illegible]	
Transportation	9		[illegible]		[illegible]	1		[illegible]
Services		14			6		2	
Environment	3		0		6	13		
Economic Structure	10		[illegible]		0	2		[illegible]

TABLE XII

FREQUENCY OF RESPONDENTS' CHOICE FOR THE MOST IMPORTANT DESCRIPTION (CITY-TOWN-VILLAGE)*

*n = 28	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	2		1		12		13	
Management & Personnel	0			20			8	
Communication Information	0		0		15	0		13
Materials	4		1		4	16		3
Socialization	1		0		2	0	25	
Production Systems	3		0		0	11		14
Work Skills	0		6		1	11		10
Training & Education	0		1		3	2		22
Marketing	0		1		6		21	
Labor	0			2			26	
Power & Energy	0		0		11	5		12
Inventions & Developments	3		3		9		13	
Industrial Organization		2			0		26	
Planning & Control		0			6		22	
Tools	6		0		12	2		8
Processes	12		1		2		13	
Scientific Development		9			1		18	
Consumer Products		4			10		14	
Occupations		0			1		27	
Transportation	1		0		6	6		15
Services		1			8		19	
Environment	5		6		15	1		
Economic Structure	0		2		7	8		11

TABLE XIII

FREQUENCY OF RESPONDENTS' CHOICE FOR THE LEAST IMPORTANT DESCRIPTION (CITY-TOWN-VILLAGE)*

*n = 28	Modern Craft Age	Modern Craft and Machine Ages	Machine Age	Machine and Power Ages	Power Age	Atomic Age	Atomic and Cybernetics Ages	Cybernetics Age
Natural Resources	5		20		0		3	
Management & Personnel	23			2			3	
Communication Information	24		2		0	1		1
Materials	18		3		0	3		4
Socialization	6		20		2	0	0	
Production Systems	22		2		3	0		1
Work Skills	18		2		6	0		2
Training & Education	17		9		1	0		1
Marketing	7		21		0		0	
Labor	19			7			2	
Power & Energy	23		4		0	0		1
Inventions & Developments	15		6		3		4	
Industrial Organization		21			5		2	
Planning & Control		25			2		1	
Tools	13		6		1	6		2
Processes	17		5		11		5	
Scientific Development		1			25		2	
Consumer Products		18			5		5	
Occupations		23			5		0	
Transportation	17		8		0	2		1
Services		21			4		3	
Environment	9		4		5	10		
Economic Structure	10		14		1	1		2

[illegible]BLE XIV

[illegible] UES FOR ALL THE [illegible]
OF INDU[illegible]IAL ARTS [illegible]

	Total Group	Junior High School	Senior High School	Edmonton, Calgary	City, Town, Village	Town Junior High School	Calgary Junior High School	Calgary Senior High School	City Junior High School	City Senior High School	Village Junior High School	Edmonton Senior High School	Town Senior High School	Edmonton Junior [illegible]
Total Group	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Junior High School		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Senior High School			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Edmonton, Calgary				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
City, Town, Village					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Town Junior High School						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Calgary Junior High School							[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Calgary Senior High School								[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
City Junior High School									[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
City Senior High School										1	[illegible]	[illegible]	[illegible]	[illegible]
Village Junior High School											[illegible]	[illegible]	[illegible]	[illegible]
Edmonton Senior High School												1	[illegible]	[illegible]
Town Senior High School													1	[illegible]
Edmonton Junior High School														1

was low. The highest correlation value in Table XIV is between the groups of Edmonton, Calgary and Junior High School, with a value of .676. This value only begins to approach a significant relationship. The lowest correlation value is between the groups of City Junior High School and Edmonton, Calgary. A close examination of Table XIV will reveal other correlation values which are spread between the lowest and highest values.

Chapter V

Conclusions and Recommendations

A statement of the purpose of this study established the parameters within which the study was done. Three sub-problems were dealt with in stages to assist in arriving at final conclusions. These were:

1. A compilation of the characteristics of productive society as based on a review of literature.

2. A description of each characteristic to show development during the five significant ages.

3. The construction of an instrument to determine the interpretation of these characteristics by the industrial arts teachers. This instrument was based upon the sub-problems in (1) and (2) above.

Summary of Findings

All opinionnaires were received and used for this study resulting in a 100 percent return which permits generalization to Alberta industrial arts teachers in 1969.

1. The source of error that resulted in the instrument's construction did not have a significant effect upon the results.

2. Standardized scale values were derived for each of the characteristics in each of the groups comprising the sample as identified in Table III, page 161. The characteristics with high positive scores (+1 or more) were Scientific Development, Training and Education, and Tools. This is interpreted to mean that teachers placed much emphasis on

these characteristics. The characteristics with least emphasis had low negative scores (-1 or less). They were Economic Structure and Occupations.

3. The frequency of respondents' choice for the most important description of each characteristic was concentrated in the atomic and cybernetics ages as illustrated in Table IV, page 169 (Total Sample).

4. The frequency of respondents' choice for the least important description of each characteristic was concentrated in the modern craft and machine ages as illustrated in Table V, page 170 (Total Sample).

5. The response patterns of the total sample for the description of each characteristic were varied and unpredictable as illustrated in Figures 33, 34, 35 and 36, pages 164, 165, 166 and 167, respectively.

6. A general similarity for the four basic groups was shown when the most important descriptions were concentrated in the atomic and cybernetics ages, and the least important descriptions were concentrated in the modern craft and machine ages. This is illustrated in Tables VI to XIII, pages 175 to 182.

The response patterns, for the relative importance of each characteristic, were unpredictable as illustrated in Figure 37, page 174.

7. The correlation values for all groups of teachers show that the values ranged from -.410 to .676, with only a

few values exceeding .350 as illustrated in Table XIV, page 183.

Conclusions

1. The method used for determining the characteristics of productive society was satisfactory for the development of a conceptual framework; however, more effort will need to be expended to arrive at more detailed and in some cases more complete characteristics of productive society. In some cases, restructuring would be necessary to achieve a more complete concept. For example, the concept of professionalization can be incorporated in greater detail under the characteristic of management and personnel. The characteristic of work skills can be broken down into more detailed sections to give a more complete description.

2. The instrument was designed to measure opinions, and results showed that response patterns (with regard to the importance of the various characteristics) were varied and did not show any predictable pattern. The importance of the various characteristics as seen by the four basic groups of teachers (Junior High School, Senior High School, Edmonton-Calgary, City-Town-Village) and as compared to the total response of the entire sample shows little or no consistency. This suggests that industrial arts teachers in general are not in agreement upon the relative importance of the various characteristics. It might also be concluded that the teachers themselves are perhaps not certain about the concept of pro-

ductive society. Table XIV in Chapter IV, which illustrates correlation values, supports the latter statement.

3. The assignment of time periods or ages to the two categories of most important and least important reveals interesting patterns. A close observation of the graphs illustrated in Figures 33, 34, 35 and 36 in Chapter IV reveals that the response patterns are irregular. This indicates that teachers are not in agreement about the importance to be ascribed to descriptions of contemporary industry and in which age emphasis should lie. If it can be agreed that industrial arts should emphasize contemporary productive society, then it is concluded that the descriptions referring to present-day productive society are not considered to be most important for all the characteristics by the industrial arts teachers. This can be clearly seen in Figures 33 and 34 in Chapter IV.

4. The opinionnaire developed for obtaining frequency and scale values of teachers' opinions about productive society was satisfactory. Part II of the opinionnaire needs to be, perhaps, redesigned to give a clearer intent of response requirements. Reliability and validity studies should be performed to establish a more powerful instrument.

5. If it can be agreed that the objectives of the industrial arts curriculum guide for the Province of Alberta set forth the content that is to be emphasized in the instruction of industrial arts, then it is questionable that these

objectives are being met. The characteristics of occupations, materials, processes, socialization, and industrial organization received little emphasis as being most important toward teaching industrial arts. Table III in Chapter IV supports this statement.

Recommendations

The following recommendations resulted from the findings:

1. The instrument used in this study should be reorganized and administered to students of industrial arts and students not involved in industrial arts to obtain comparisons of understandings about productive society.

2. It would be interesting to observe results of the instrument used in this study on the following groups of people: (a) industrialists, (b) administrators--industry and education, and (c) academic teachers.

3. The instrument should be redesigned to measure factual knowledge rather than opinions and administered to industrial arts teachers and students in general to determine their knowledge of the concept of productive society.

4. If it can be agreed that the concept of productive society is an important segment of education which requires an understanding by Alberta youth, and if it can be agreed that industrial arts should accept the responsibility of transmitting this understanding, then it is logical that further research and evaluation of the concept of productive

society is needed in an attempt to make its meaning more consistent with industrial arts teachers in Alberta.

5. Little has been done in the past to develop instruments which are of use for determining the understanding of productive society. The instrument developed for this study could serve as a basis upon which further research is conducted to determine the understanding of productive society.

6. Finally, it is recommended that the characteristics of productive society be reorganized to include:

   a. A complete description of each characteristic in a contemporary setting, and

   b. Provisions in the structuring technique to make additions as technology and time progresses. The structure could be such that an up-to-date description of various concepts can be maintained.

This researcher is in complete agreement with Blomgren (1962), who stated:

> The dimensions of industry in America are almost boundless. Much more needs to be done to identify the most important and basic element of industry that all industrial educators must know to be able to perform their jobs in a satisfactory manner. A minimum level of demonstrated understanding needs to be established. Possibly some research needs to be done to identify the people who truly understand industrial America.

Reference to the above statement by Blomgren can be very easily applied to Canadian industry.

References

Allen, F. R., Hart, H., Miller, D. C., Ogburn, W. F., and Nimkoff, M. F. Technology and social change. New York: Appleton-Century-Crofts, 1957.

Aron, R. (Ed.). World technology and human destiny. Ann Arbor: The University of Michigan Press, 1963.

Ashby, W. R. An introduction to cybernetics. London: Chapman and Hall, 1958.

Ashton, T. S. The industrial revolution 1760-1830. New York: Oxford University Press, 1964.

Bain, J. S. Industrial organization. New York: John Wiley and Sons, 1968.

Barkin, S. Educating students for personal and economic growth in a dynamic technological society. American Vocational Journal, 1961, 36, 17-18.

Barlow, M. L. History of industrial education in the United States. Chicago: Charles A. Bennett, 1967.

Bello, F. Industrial research geniuses now welcome. Fortune, 1965, 5, 96-150.

Bendix, R. Max Weber. Garden City, New York: Doubleday and Company, 1960.

Black, M. (Ed.). The social theories of Talcott Parsons. Englewood Cliffs, New Jersey: Prentice-Hall, 1961.

Blau, P. M., Gustad, J. W., Jessor, R., Parnes, H. S., and Wilcock, R. C. Occupational choice: A conceptual framework. Industrial and Labor Relations Review, 1956, 9, 531-543.

Blomgren, R. D. An experimental study to determine the relative growth of a selected group of industrial arts education majors toward gaining an understanding of American industry. Unpublished Doctoral Dissertation, University of Illinois, 1962.

Bober, M. M. Karl Marx's interpretation of history. Cambridge: Harvard University Press, 1950.

Bowen, H. R. Report of the National Commission on Technology, Automation and Economic Progress. Technology and the American Economy, Vol. I, U. S. Printing Office, 1966.

Brickman, W. W., and Lehrer, S. (Eds.). Automation, education and human values. New York: School and Society Books, 1966.

Bridenbaugh, C. The colonial craftsman. Chicago: The University of Chicago Press, 1961.

Bright, J. R. Opportunity and threat in technological change. Harvard Business Review, 1963, 41, 76-86.

Bryce, M. D. Industrial development. New York: McGraw-Hill, 1960.

Bryce, M. D. Policies and methods for industrial development. New York; McGraw-Hill, 1965.

Buchanan, R. A. Technology and social progress. Oxford: Pergamon Press, 1965.

Buckingham, W. Automation. New York: The New American Library of World Literature, 1961.

Buffa, E. S. Modern production: Management. New York: John Wiley and Sons, 1963.

Burck, G. The still bright promise of productivity. Fortune, 1968, 77, 134-224.

Burke, J. G. (Ed.). The new technology and human values. Belmont, California: Wadsworth Publishing Company, 1966.

Burlingame, R. Backgrounds of power. New York: Charles Scribner and Sons, 1949.

Cabot, R. C. What men live by. New York: Houghton-Mifflin, 1914.

Caplow, T. The sociology of work. New York: McGraw-Hill, 1954.

Carol, H. Stages of technology and their impact upon physical environment: A basic problem in cultural geography. The Canadian Geographer, 1964, 8, 1-7.

Chamberlain, N. W. Source book on labor. New York: McGraw-Hill, 1958.

Chase, S. Men and machines. New York: Macmillan Company, 1929.

Chase, S. Men at work. New York: Harcourt, Brace and Company, 1941.

Clark, B. R. Educating the expert society. San Francisco: Chandler Publishing Company, 1962.

Clarke, A. C. Profiles of the future. New York: Harper and Row, 1958.

Conant, J. B. Education in a divided world. Cambridge: Harvard University Press, 1949.

Conant, J. B. Modern science and modern man. New York: Columbia University Press, 1952.

De Garmo, P. E. Materials and processes in manufacturing. New York: Macmillan Company, 1957.

Davenport, J. Japan's competitive cutting edge. Fortune, 1968, 79, 92-101.

Davis, R. C. Industrial organization and management. New York: Harper and Brothers, 1956.

Dawson, C. In Mulloy, J. J. (Ed.). The dynamics of world history. London: Sheed and Ward, 1957.

Dawson, K. E. Industrial Arts and the world of work. Educational Leadership, 1964, 22, 236-238.

Dean, J. Managerial economics. New York: Prentice-Hall, 1951.

Diebold, J. Automation. New York: D. Van Nostrand Company, 1952.

Diebold, J. Beyond automation. New York: McGraw-Hill, 1964.

Drucker, P. F. The concept of the corporation. New York: The New American Library, 1964.

Drucker, P. F. The future of industrial man. Toronto: The New American Library of Canada, 1965.

Dubin, R. Working union management relations. Englewood Cliffs, New Jersey: Prentice-Hall, 1958.

Dubin, R. The world of work. Englewood Cliffs, New Jersey: Prentice-Hall, 1958.

Eddy, J. R. D. T and I in the 60's. American Vocational Journal, 1960, 35, 10-12.

Elbourne, E. T. Fundamentals of industrial administration. London: MacDonald and Evans, 1934.

Encyclopaedia Americana, Canadian Edition, Montreal Corporation of Canada, 1963. Vols. 15, 22, 25, and 27.

Encyclopaedia Britannica, Encyclopaedia Britannica, Inc. Chicago: William Benton, 1968. Vols. 7 and 12.

Evans, R. N. Industry and the content of industrial education. School Shop, 1962, 21, 29-31.

Fabricant, S. Measurement of technological change. Seminar on Manpower Policy and Program. U. S. Department of Labor, July, 1965.

Fairchild, J. E., and Londman, D. (Eds.). America faces the nuclear age. New York: Sheridan House, 1961.

Fisher, B. M. Industrial education. Madison: The University of Wisconsin Press, 1967.

Form, W. H., and Miller, D. C. Industry, labor, and the community. New York: Harper and Brothers, 1960.

Foster, G. M. Traditional cultures: And the impact of technological change. New York: Harper and Brothers, 1962.

Galbraith, J. K. The affluent society. Boston: Houghton-Mifflin, 1960.

Galbraith, J. K. Economic development in perspective. Cambridge: Harvard University Press, 1962.

Galbraith, J. K. The new industrial state. Boston: Houghton-Mifflin, 1967.

Gellerman, S. W. Motivating men with money. Fortune, 1968, 77, 144-145.

Gerth, H. H., and Mills, C. W. (Eds.). From Max Weber: Essays in sociology. New York: Oxford University Press, 1946.

Ghiselli, E. E., and Brown, C. W. Personnel and industrial psychology. New York: McGraw-Hill, 1955.

Ginzberg, E. (Ed.). Technology and social change. New York: Columbia University Press, 1964.

Goodman, L. L. Man and automation. London: Unwin Brothers, 1957.

Graves, C. W. Deterioration of work standards. Harvard Business Review, 1966, 44, 117-121.

Greene, D. E. Production technology. London: Chapman and Hall, 1962.

Halmos, P. (Ed.). The sociological review monograph no. 8: The development of industrial societies. Keele: University of Keele, 1964.

Heilbroner, R. L. Automation in the perspective of long term technological change. Seminar on Manpower Policy and Program. U. S. Department of Labor, December, 1966.

Hilton, A. M. (Ed.). The evolving society. New York: The Institute for Cybercultural Research, 1966.

Hosolitz, B. F., and Moore, W. E. (Eds.). Industrialization and society. Mouton: UNESCO, 1963.

Hostetler, I. Industrial arts in 1975: Hopes for the future. Industrial Arts and Vocational Education, 1962, 51, 18-20.

Hughes, T. P. The development of western technology since 1500. New York: Macmillan Company, 1964.

Industrial Arts Teachers, 1968-69. Edmonton: Department of Education, Province of Alberta, Fall, 1968.

Ireson, W. G., and Grant, E. L. Handbook of industrial engineering and management. Englewood Cliffs, New Jersey: Prentice-Hall, 1955.

Jehring, J. J. (Ed.). Productivity and automation. National Council for the Social Studies. Washington, D. C.: Department of the National Education Association, 1966.

Kauffman, H. J. Mandate for change. School Shop, 1964, 24, 29-30.

Kendrick, J. W., and Pech, M. R. Productivity trends in the United States. Princeton: Princeton University Press, 1961.

Klemm, F. A history of western technology. Translated by Singer, D. W. Cambridge: MIT Press, 1964.

Kranzberg, M., and Pursell, C. W., Jr. (Eds.). Technology in western civilization. Vol. 1. New York: Oxford University Press, 1967.

Laird, D. A., and Laird, E. C. How to get along with automation. New York: McGraw-Hill, 1964.

Lansdell, N. The atom and the energy revolution. St. Albans, Great Britain: Campbell Press, 1958.

Lewis, B. T., and Pearson, W. W. Management guide to applied industrial psychology. New York: John F. Rider, 1960.

Lipset, S. M., and Smelser, N. J. Sociology and the progress of a decade. Englewood Cliffs, New Jersey: Prentice-Hall, 1961.

Luetkemeyer, J. F. (Ed.). A historical perspective of industry. 17th Yearbook. American Council of Industrial Arts Teacher Education, 1968.

McIrvine, E., Cozart, W. R., Kean, R., DeCarlo, C. R., Bloy, J. B., Jr., Landau, J., and Theobald, R. Dialogue on technology. New York: Bobbs-Merrill, 1967.

McLuhan, M. Understanding media: The extensions of man. New American Library, 1964.

Maguire, T. O. Value components of teachers; judgements of educational objectives. Unpublished Doctoral Dissertation, University of Illinois, 1967.

Marx, K. Capital, Vol. 2. Engels, F. (Ed.). New York: International Publishers, 1967.

Mayer, R. R. Production management. New York: McGraw-Hill, 1968.

Maynard, H. G. Industrial engineering handbook. New York: McGraw-Hill, 1956.

Michael, D. N. Cybernation: A silent conquest. Santa Barbara, California: Fund for the Republic, 1962.

Michael, D. N. The next generation. New York: Random House, 1965.

Miller, D. C., and Form, W. H. Industrial sociology. (2nd ed.) New York: Harper and Row, 1964.

Moore, W. E. Industrial relations and the social order. New York: Macmillan Company, 1951.

Moore, W. E. The conduct of the corporation. New York: Random House, 1962.

Moore, W. E., and Smelser, N. J. (Eds.). The impact of industry. Englewood Cliffs, New Jersey: Prentice-Hall, 1965.

Moore, W. E. Order and change. New York: John Wiley and Sons, 1967.

Morris, B. R. Economic growth and development. New York: Pitman Publishing, 1967.

Morse, D., and Warner, A. W. (Eds.). Technological innovation and society. New York: Columbia University Press, 1966.

Mumford, L. Technics and civilization. New York: Harcourt, Brace and World, 1963.

NPA Special Policy Committee. Reports on the productive uses of nuclear energy. Washington, D. C.: National Planning Association, 1957.

Neff, K. L. Education and the development of human technology. U. S. Department of Health, Education and Welfare, 1962.

Nelson, R. R., Peck, M. J., and Kalachek, E. D. Technology, economic growth and public policy. Washington, D. C.: Brookings Institution, 1967.

New theory of growth: The leaders set the pattern. Business Week, 1960, 1626, 128-129.

Nosow, S., and Form, W. H. (Eds.). Man, work and society. New York: Basic Books, 1962.

Oliver, J. W. History of American technology. New York: Ronald Press, 1956.

Osgood, E. L. _A history of industry_. Boston: Ginn and Company, 1935.

Parsons, T. _The social system_. Glencoe, Illinois: Free Press, 1951.

Parsons, T., and Smelser, N. J. _Economy and society_. London: Routhledge and Kegan Paul, 1957.

Philipson, M. _Automation implications for the future_. New York: Random House, 1962.

Population 1--Trends, 1967. Edmonton: Department of Municipal Affairs, Province of Alberta, Spring, 1967.

Population 2--Density, 1967. Edmonton: Department of Municipal Affairs, Province of Alberta, Spring, 1967.

Population, 1968. Edmonton: Alberta Bureau of Statistics, Spring, 1968.

Quin, J. B. Technological competition: Europe vs. U. S. _Harvard Business Review_, 1966, 44, 113-123.

Ras, N. Society, technology and development. _Americas_, 1966, 18, 15-17.

Roethlisberger, F. J. _Man-in-Organization_. Cambridge: Belknap Press, 1968.

Salter, W. E. G. _Productivity and technical change_. Cambridge: Harvard University Press, 1966.

Silberman, C. E. Is technology taking over? _Fortune_, 1966, 73, 112-115.

Skinner, W. Production under pressure. _Harvard Business Review_, 1966, 44, 139-146.

Smith, A. _The wealth of nations_. New York: Random House, 1937.

Solow, H. Automation: News behind the noise. _Fortune_, 1956, 53, 150-55.

Soule, G. _The shape of tomorrow_. New York: New American Library, 1958.

Stokes, P. M. _The total systems approach to management control_. American Management Association, 1968.

Stover, C. F. _The government of science_. A report for the study of democratic institutions. Santa Barbara, California, 1962.

Technology, the cybernated generation. _Time_, 1965, 85, 68-71.

Thurston, P. H. The concept of a production system. _Harvard Business Review_, 1963, 41, 70-74.

Thurstone, L. L. The method of paired comparisons for social values. _Journal of Abnormal Psychology_, 1926-27, 21, 384-400.

Thurstone, L. L. The measurement of opinion. _Journal of Abnormal Psychology_, 1927-28, 22, 415-430.

Thurstone, L. L. The measurement of social attitudes. _Journal of Abnormal Psychology_, 1931-32, 26, 249-269.

Thurstone, L. L. Experimental methods in food tasting. Journal of Abnormal Psychology, 1951, 35, 141-145.

Torgerson, W. S. _Theory and methods of scaling_. New York: John Wiley and Sons, 1958.

Toynbee, A. J. 2000 A. D. _Time_, 1952, 60, 34.

Trow, W. C. Teacher and technology. _New designs for learning_. New York: Meredith Publishing Company, 1963.

Vance, S. _Industrial administration_. New York: McGraw-Hill, 1959.

Vance, S. _Industrial structure and policy_. Englewood Cliffs, New Jersey: Prentice-Hall, 1961.

Venn, G., and Marchese, T. J., Jr. _Man, education and work_. Washington, D. C.: American Council on Education, 1964.

Vincent, M. J., and Mayers, J. _New foundations for industrial sociology_. Princeton: D. Van Nostrand Company, 1959.

Walker, C. R. _Toward the automatic factory_. New Haven: Yale University Press, 1957.

Walker, C. R., and Walker, A. G. _Modern technology and civilization_. New York: McGraw-Hill, 1962.

Walker, C. R., and Walker, A. G. *Technology, industry and man: The age of acceleration*. New York: McGraw-Hill, 1968.

Ward, B. *Five ideas that change the world*. New York: W. W. Norton and Company, 1959.

Ward, B. *Toward a world of plenty*. Toronto: University of Toronto Press, 1963.

Warner, W. L., and Martin, N. H. (Eds.). *Industrial man*. New York: Harper and Brothers, 1959.

Weber, M. *The Protestant ethic*. Parsons, T. (Trans.). New York: Charles Scribner and Sons, 1958.

Wiener, N. The human use of human beings. Boston: Houghton Mifflin, 1950.

Wilkie, L. A. *Civilization through tools*. Des Plaines, Illinois: Wilkie Brothers Foundation. An Educational Presentation, Chart.

Williams, W. A. *The great evasion*. Chicago: Quadrangle Books, 1964.

Whitehead, A. N. *Science and the modern world*. New York: New American Library, 1953.

Ziel, H. R. (Ed.). *Education and productive society*. Conference proceedings, University of Alberta. Toronto: W. J. Gage, June, 1964.

Appendix A

Opinionnaire on Productive Society (Pilot)

Your name, along with 50 other Industrial Arts teachers has been randomly selected from a complete list of Industrial Arts teachers in Alberta. I have made contact with you, with the hope that you will respond to a questionnaire that deals with the characteristics of productive society. The questionnaire is divided into two parts; detailed instructions precede each part.

The entire task will take you about 45 minutes to perform (the task may appear enormous at first, but can be quickly completed once started). Because only a small portion of the entire Industrial Arts teachers are included in my sample, it is important that all of the questionnaires be returned if my analysis of your responses is to be meaningful.

<u>REMEMBER</u>

There are no right or wrong answers. Let your own opinions about the various characteristics guide each of your responses.

PART ONE

This part of the questionnaire is designed so that YOU can tell me what YOU consider are the most important characteristics of productive society in the teaching of YOUR industrial arts classes.

Examine the following pairs of characteristics. Please indicate by an X which characteristic of each pair you think is the more important one in the teaching of your classes.

Sample Question:

When teaching industrial arts, I believe the most important characteristic of productive society is:

Industrial relations -------------- X
Research------------------------------

If you place your X opposite industrial relations, then you are telling me that, in your opinion you believe it is more important that industrial arts students be taught content related to the field of industrial relations rather than content related to the field of research. Keep this in mind when responding to each pair of characteristics.

NOTE:

1. Respond to every pair
2. Mark only one response for every pair
3. Do not spend time over any one pair of characteristics
4. There are no right or wrong answers

PLEASE REMEMBER TWO THINGS

1. The frame of reference to keep in mind is: WHEN TEACHING INDUSTRIAL ARTS, I BELIEVE THE MOST IMPORTANT CHARACTERISTIC OF PRODUCTIVE SOCIETY IS:

2. Make your choice to the above reference only from PAIRS OF CHARACTERISTICS (The pairs of characteristics now follow).

OPINIONNAIRE OF PRODUCTIVE SOCIETY

PART ONE

WHEN TEACHING INDUSTRIAL ARTS, I BELIEVE THE MORE IMPORTANT CHARACTERISTIC OF PRODUCTIVE SOCIETY IS:

Communication Information .... | .... Environment .... |	Natural Resources .... | .... Inventions and Development .... | ....
Natural Resources .... | .... Planning and Control .... |	Power and Energy .... | .... Work Skills .... | ....
Production Systems .... | .... Consumer Products .... |	Labor .... | .... Training and Education .... | ....
Natural Resources .... | .... Scientific Development .... |	Power and Energy .... | .... Transportation .... | ....
Natural Resources .... | .... Tools .... |	Processes .... | .... Service Industries .... | ....
Consumer Products .... | .... Environment .... |	Labor .... | .... Economic Structure .... | ....
Marketing .... | .... Planning and Control .... |	Production Systems .... | .... Service Industries .... | ....
Transportation .... | .... Environment .... |	Production Systems .... | .... Planning and Control .... | ....
Processes .... | .... Consumer Products .... |	Power and Energy .... | .... Environment .... | ....
Natural Resources .... | .... Materials .... |	Tools .... | .... Marketing .... | ....
Labor .... | .... Management and Personnel .... |	Natural resources .... | .... Production Systems .... | ....
Tools .... | .... Economic Structure .... |	Natural Resources .... | .... Training and Education .... | ....

Work Skills
Processes

Power and Energy
Labor

Communication Information
Industrial Organization

Scientific Development
Planning Control

Economic Structure
Industrial Organization

Processes
Occupations

Industrial Organization
Marketing

Training and Education
Service Industries

Inventions and Development
Processes

Planning and Control
Environment

Training and Education
Occupations

Inventions and Development
Marketing

Work Skills
Production Systems

Production Systems
Socialization

Communication Information
Labor

Processes
Socialization

Tools
Planning and Control

Processes
Labor

Inventions and Development
Production Systems

Planning and Control
Socialization

Tools
Occupations

Marketing
Occupations

Power and Energy
Processes

Natural Resources
Work Skills

Materials
Management and Personnel

Environment
Socialization

Economic Structure
Marketing

Service Industries
Environment

Tools
Training and Education

Marketing
Environment

Planning and Control
Occupations

Occupations
Environment

Marketing
Socialization

Management and Personnel
Economic Structure

Power and Energy
Production Systems

Marketing
Training and Education

Labor
Industrial Organization

Marketing
Service Industries

Management and Personnel
Environment

Processes
Planning and Control

Power and Energy
Training and Education

Scientific Development
Management and Personnel

Industrial Organization
Service Industries

Economic Structure
Service Industries

Production Systems
Processes

Work Skills
Socialization

Natural Resources
Environment

Management and Personnel
Economic Structure

Communication Information
Service Industries

Power and Energy
Scientific Development

Transportation
Training and Education

Processes
Transportation

Materials
Processes

Labor
Marketing

Materials
Production Systems

Materials
Economic Structure

Materials
Industrial Development

Work Skills
Scientific Development

Work Skills
Inventions and Development

Inventions and Development
Occupations

Materials
Communication Information

Transportation
Economic Structure

Labor
Occupations

Materials
Marketing

Production Systems
Economic Structure

Communication Information
Economic Structure

Power and Energy
Planning and Control

Transportation
Labor

Materials
Transportation

Tools
Consumer Products

Communication Information
Training and Education

Transportation
Marketing

Processes
Industrial Organization

Labor
Environment

Tools
Communication Information

Materials
Planning and Control

Processes
Management and Personnel

Communication Information
Marketing

Power and Energy
Occupations

Inventions and Development
Socialization

Power and Energy
Industrial Organization

Production Systems
Transportation

Labor
Consumer Products

Processes
Economic Structure

Marketing ....
Consumer Products ....

Power and Energy ....
Natural Resources ....

Communication Information ....
Planning and Control ....

Transportation ....
Industrial Organization ....

Labor ....
Service Industries ....

Processes ....
Communication Information ....

Service Industries ....
Consumer Products ....

Inventions and Development ....
Transportation ....

Processes ....
Training and Education ....

Planning and Control ....
Service Industries ....

Power and Energy ....
Materials ....

Production Systems ....
Communication Information ....

Industrial Organization ....
Training and Education ....

Materials ....
Training and Education ....

Scientific Development ....
Industrial Organization ....

Training and Education ....
Socialization ....

Consumer Products ....
Socialization ....

Communication Information ....
Consumer Products ....

Transportation ....
Occupations ....

Inventions and Development ....
Service Industries ....

Work Skills ....
Transportation ....

Planning and Control ....
Training and Education ....

Scientific Development ....
Economic Structure ....

Production Systems ....
Management and Personnel ....

Processes ....
Environment ....

Management and Personnel ....
Consumer Products ....

Work Skills ....
Environment ....

Inventions and Development ....
Service Industries ....

Management and Personnel ....
Socialization ....

Tools ....
Transportation ....

Production Systems ....
Industrial Organization ....

Natural Resources ....
Marketing ....

Production Systems ....
Marketing ....

Materials ....
Labor ....

Materials ....
Service Industries ....

Tools ....
Work Skills ....

Natural Resources ....
Socialization ....

Tools ....
Materials ....

Scientific Development ....
Marketing ....

Communication Information ....
Socialization ....

Transportation ....
Service Industries ....

Natural Resources ....
Consumer Products ....

Industrial Organization ....
Socialization ....

Occupations ....
Service Industries ....

Economic Structure ....
Planning and Control ....

Transportation ....
Consumer Products ....

Labor ....
Socialization ....

Economic Structure ....
Training and Education ....

Inventions and Development ....
Management and Personnel ....

Management and Personnel ....
Marketing ....

Training and Education ....
Environment ....

Tools ....
Environment ....

Transportation ....
Management and Personnel ....

Inventions and Development ....
Environment ....

Tools ....
Service Industries ....

Scientific Development ....
Socialization ....

Tools	Natural Resources
Processes	Management and Personnel
Natural Resources	Production Systems
Service Industries	Labor
Management and Personnel	Work Skills
Occupations	Management and Personnel
Scientific Development	Inventions and Development
Environment	Scientific Development
Inventions and Development	Tools
Consumer Products	Management and Personnel
Industrial Organization	Work Skills
Occupations	Occupations
Scientific Development	Natural Resources
Communication Information	Industrial Organization
Work Skills	Materials
Industrial Organization	Consumer Products
Economic Structure	Inventions and Development
Consumer Products	Consumer Products
Management and Personnel	Inventions and Development
Service Industries	Occupations
Industrial Organization	Economic Structure
Environment	Socialization
Work Skills	Work Skills
Planning and Control	Marketing
Scientific Development	Tools
Transportation	Inventions and Development
Industrial Organization	Inventions and Development
Planning and Control	Industrial Organization

Transportation
Communication Information

Work Skills
Economic Structure

Planning and Control
Consumer Products

Power and Energy
Socialization

Labor
Planning and Control

Materials
Scientific Development

Natural Resources
Labor

Inventions and Development
Communication Information

Production Systems
Environment

Work Skills
Service Industries

Occupations
Consumer Products

Power and Energy
Consumer Products

Materials
Inventions and Development

Communication Information
Management and Personnel

Natural Resources
Communication Information

Materials
Occupationns

Inventions and Development
Economic Structure

Occupations
Socialization

Materials
Socialization

Inventions and Development
Labor

Natural Resources
Processes

Power and Energy
Marketing

Tools
Scientific Development

Transportation
Socialization

Work Skills
Training and Education

Inventions and Development
Training and Education

Power and Energy
Tools

Management and Personnel
Industrial Organization

Service Industries
Socialization

Work Skills
Labor

Natural Resources
Transportation

Economic Structure
Occupations

Management and Personnel
Planning and Control

Power and Energy
Service Industries

Tools
Industrial Organization

Power and Energy
Inventions and Development

Tools
Socialization

Scientific Development
Production Systems

Natural Resources
Occupations

Power and Energy
Economic Structure

Training and Education
Consumer Products

Scientific Development
Processes

Production Systems
Occupations

Tools
Labor

Scientific Development
Training and Education

Production Systems
Training and Education

Materials
Work Skills

Power and Energy
Management and Personnel

Management and Personnel
Training and Education

Economic Structure
Environment

Power and Energy
Communication Information

Natural Resources
Economic Structure

Scientific Development
Labor

Industrial Organization
Consumer Products

Work Skills
Communication Information

Materials
Environment

Transportation	
Planning and Control	
Processes	
Marketing	
Communication Information	
Occupations	

You've now completed PART ONE of my opinionnaire — thanks again.

Before you move on to PART TWO, would you please flip back through the preceeding 9 pages to ensure that you've responded to each of the pairs of characteristics.

PART TWO

Part two contains a total of 23 sets of statements. Each set consists of a series of descriptions of a particular characteristic of productive society. Please examine the statements in each set and make two decisions:

1. Which description of a particular characteristic, is the most important one when teaching industrial arts.

2. Which description of a particular characteristic is the least important when teaching industrial arts.

Indicate your choice by placing the letter of the statement you choose in the space provided at the end of each question, which appears like this:

________ is the most important
________ is the least important

Sample Question:

When teaching the concept of Research as a characteristic of productive society in my industrial arts class, it is my opinion that content which emphasizes:

__C__ is most important

__D__ is the least important

A The utilization of one or two persons to conduct research
B Research is not significantly important
C The use of computers and skilled technicians to conduct research on a comprehensive basis
D The use of research only in educational institutions
E None of the above

If, for example, you indicate C as the most important description, then you are telling me that, in your opinion, you believe that content related to extensive use of research is most important when teaching about research in your industrial arts classes. If you indicate D as the least important then you are telling me that research carried on in educational institutions is of no importance to you. (Keep this in mind when making your response).

PLEASE NOTE:

1. Whether you teach some of the characteristics or not, please respond to every set of descriptions.

2. Do not make more than two responses per each set.

1. When teaching the concept of Natural Resources as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A Development of forests, land, minerals and water resourses
B Enforcing the conservation movement and more extensive use of research
C The use of coal and iron
D Use of land for agriculture and forests for structure and fuel
E None of the above

2. When teaching the concept of Management and Personnel as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A Existence of bureaucratic control, heirarchial structure and techniques of innovations
B Involvement of managers, foreman, inspectors and a simple authority structure
C One man who controls the entire production
D None of the above

3. When teaching the concept of Communication Information as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

______ is most important

______ is least important

A The use of transistor, laser, long distance communication and electronics minaturization
B Radio, motion picture, television, microfilm, magnetic tape
C Communication by water, rail, telephone, telegraph
D Communication by messenger and word of mouth
E Two way radio, radar, vacuum tube control of equipment
F None of the above

4. When teaching the concapt of Materials as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

______ is most important

______ is least important

A The use of wood, iron and bronze
B The use of powdered metals, and alloys for greater strength and heat resistance
C The use of steel and copper
D The use of alloyed steels and aluminum alloys
E The use of plastics, super alloys, magnesium and titanium
F None of the above

5. When teaching the concept of Socialization as a characteristic of productive society in my industrial arts classes it is my opinion that content which emphasizes:

______ is most important

______ is least important

A Decline of the rural community
B Integration of societies and various cultures
C Leisure time, mass society, modernization, technological influence
D The family group is most important
E None of the above

6. When teaching the concept Production Systems as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A The use of transfer machines to replace manual material handling
B The use of quality control, inspection, computer controlled production lines and systems organization
C The application of machines to cutting tools which are manually controlled
D Employing systems of mass production, automation and standardization
E The use of simple hand tools, manually operated
F None of the above

7. When teaching the concept Work Skills as a characteristic of productive society in my industrial arts classes it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A Skilled inspector and mechanic used where mechanical operations replace the need for machine feeding or tending
B The use of a generally skilled craftsman and unskilled manual labor
C Highly skilled technicians used for increased maintanence and computer programming
D A combination of machine use and skilled craftsman
E The need for technicians, designers and planners
F None of the above

8. When teaching the concept of Training and Education as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A The significance of apprenticeship
B Simple education based upon religion, reading, writing and arithmetic.
C The significance of science and mathematics in the process of education
D The use of manual training and some industrial training and general education.
E The importance of general education, professionalization, highly skilled industrial training, computer instruction
F None of the above

9. When teaching the concept of <u>Marketing</u> as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A Involvement of foreign competition, increased consumption, improved stratigies for marketing
B Demand exceeds supply because of poor production techniques
C Small amount of trade with foreign countries
D Emphasis on increasing local and foreign consumption
E None of the above

10. When teaching the concept of <u>Labor</u> as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A Labor is characterized by collective bargaining, worker morale, specialization, incentives, work motivation and conciliation.
B Labor involves a single craftsman who constitutes the sole form of productivity
C Employee - employer relations are such that there is little regulation of worker time and conditions and the existence of only a few unions.
D None of the above

11. When teaching the concept of <u>Power and Energy</u> as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A Use of muscle, wind and water.
B Use of steam and the steam engine.
C Significance of electricity, petroleum, internal combustion engine and portable power.
D Development of atomic energy, hydraulic and jet power.
E Use of neculear power, natural gas and solar energy conversion.
F None of the above

12. When teaching the concept of Inventions and Development as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A The development of power conversion and mass production of textiles, iron and steel machinery.
B Development of scientific and technical research laboratories manned by professional inventors.
C Development of certain techniques which include the wheel, extracting process, metal bridges and the use of gases.
D Development of mining, textile machinery and the establishment of modern chemistry to improve processes
F None of the above

13. When teaching the concept of Industrial Organization as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A Individual owned and operated business enterprizes and the establishment of craft guilds.
B Small companies privately owned with little organization control and the need for vast sums of money.
C Organization was based upon corporations, utilities, public ownership, stock holders, and government control.
D None of the above

PLEASE REMEMBER

Each set of statements contains several descriptions of a particular characteristic of productive society. Examine each description and make two decisions.

1. Which description of a particular characteristic is the most important one when teaching industrial arts.
2. Which description of a particular characteristic is the least important when teaching industrial arts.

14. When teaching the concept of Planning and Control as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes;

_______ is most important

_______ is least important

A Characterized by computers, data processing, numerical control, efficiency study, and quality control.
B Planning is performed by a single individual using blue printing and simple specifying and no quality control.
C The use of some feedback for purposes of data evaluation and processing and mechanization improvement.
D None of the above.

15. When teaching the concept of Tools as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A The use of simple hand tools for simple operations
B Ultra high speed computers and machine tools
C Simple machines based upon wheel and shaft principle.
D The use of automatic machines to extend simple machines
E The automatic factory was made possible because of precision.
F None of the above

16. When teaching the concept of Processes as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_______ is most important

_______ is least important

A Sheet glass, metal drawing, assembly line, extruding
B Bessemer and open hearth steel, hydraulic pressing
C Iron puddling, slip casting, cerventation carburization
D Casting, forging, wood turning and casting on process
E None of the above

17. When teaching the concept Scientific Development as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes;

______ is most important

______ is least important

A Scientific and technological work has become similar and science serves as a basis for further technological developments.
B Mathematics is clearly related to science and scientific developments are based upon simple principles.
C Certain developments in biology, chemistry and physics do not relate to industry and do not affect it.
D None of the above.

18. When teaching the concept Consumer Products as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes;

______ is most important

______ is least important

A Household appliances, guarantees, luxury items synthetic materials.
B Emphasis on simple utilitarian and asthetic goods.
C Enterpreneurialship, supply sufficient for all demands, retail - wholesale selling.
D None of the above.

19. When teaching the concept of Occupations as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

______ is most important

______ is least important

A Occupations are simple and do not involve detailed catagorizations.
B Specialization, social mobility, job classifications are a part of occupations.
C Some occupational structure is evident with influence of class lines.
D None of the above

20. When teaching the concept of Transportation as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

______ is most important

______ is least important

A Short range, small freight movement on land and water
B Use of steamship and train for some continental travel.
C Use of large freight carrying air craft and electronic control of road and air ways.
D Use of jet aircraft and improved atomic applications
E Use of diesel, conventional air craft and improved roads for local travel.
F None of the above.

21. When teaching the concept of Services as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

______ is most important

______ is least important

A Maintenance and hardware service for small applications
B Service industries such as hospitals, universities, government and domestic.
C Not significant
D None of the above.

22. When teaching the concept of Environment as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

______ is most important

______ is least important

A Physical factors had an influence upon industrialization.
B Production techniques had an influence upon industrialization.
C Sociocultural factors had an influence upon industrialization.
D Production design factor had an influence upon industrialization.
E None of the above.

23. When teaching the concept Economic Structure as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

______ is most important

______ is least important

A Large scale capital investment into research and development
B The use of limited outlay and profits with only a few wealthy
C Investment into industry is not important
D Increased productivity caused increased investment
E Large capital investment good public ownership
F None of the above

Appendix B

Opinionnaire on Productive Society

OPINIONNAIRE ON PRODUCTIVE SOCIETY

Your name, along with 50 other Industrial Arts teachers, has been randomly selected from a complete list of Industrial Arts teachers in Alberta. I am contacting you, with the hope that you will respond to the enclosed questionnaire that deals with the characteristics of productive society. The questionnaire is divided into two parts; detailed instructions precede each part.

The entire task will take you about 45 minutes to perform. (The task may appear enormous at first, but can be quickly completed once started.) Because only a small portion of the entire Industrial Arts teachers are included in my sample, it is important that all of the questionnaires be returned if my analysis of your responses is to be generalizeable.

REMEMBER

There are no right or wrong answers. Let your own opinions about the various characteristics guide each of your responses. All responses will remain strictly anonymous, and the analysis will be by groups of teachers so that no individual can be identified either by myself, or by readers of the thesis.

PART ONE

This part of the questionnaire is designed so that YOU can tell me what YOU consider are the most important characteristics of productive society in the teaching of YOUR industrial arts classes.

Examine the following pairs of characteristics. Please indicate by an X which characteristic of *each pair* you think is *the more important one* in the teaching of your classes.

Sample Question:

When teaching industrial arts, I believe the more important characteristic of productive society is:

Industrial Relations................	X
Research............................	

If you place your X opposite industrial relations, then you are telling me that, in your opinion, you believe it is more important that industrial arts students be taught content related to the field of industrial relations rather than content related to the field of research.

Keep the [unstated] common stem in mind when responding to each pair of characteristics.

NOTE:

1. Respond to every pair.
2. Mark only one response for every pair.
3. Do not spend excessive time over any one pair of characteristics.
4. There are no right or wrong answers.

PLEASE REMEMBER TWO THINGS

1. For Part One of the questionnaire, the frame of reference to keep in mind is: WHEN TEACHING INDUSTRIAL ARTS, I BELIEVE THE MORE IMPORTANT CHARACTERISTIC OF PRODUCTIVE SOCIETY IS:

2. There are 252 pairs of characteristics. Please make one response for each pair.

The characteristics have been derived from an extensive review of literature and may appear somewhat vague. Please let YOUR own thoughts about each characteristic guide your responses. Please do not concern yourself with the statistical analysis of the questionnaire. (The pairs of characteristics now follow.)

OPINIONNAIRE OF PRODUCTIVE SOCIETY

PART ONE

WHEN TEACHING INDUSTRIAL ARTS, I BELIEVE THE MORE IMPORTANT CHARACTERISTIC OF PRODUCTIVE SOCIETY IS:

Communication Information ....| ....
Environment ....| ....

Natural Resources ....| ....
Planning and Control ....| ....

Production Systems ....| ....
Consumer Products ....| ....

Natural Resources ....| ....
Scientific Development ....| ....

Natural Resources ....| ....
Tools ....| ....

Consumer Products ....| ....
Environment ....| ....

Marketing ....| ....
Planning and Control ....| ....

Transportation ....| ....
Environment ....| ....

Processes ....| ....
Consumer Products ....| ....

Natural Resources ....| ....
Materials ....| ....

Labor ....| ....
Management and Personnel ....| ....

Tools ....| ....
Economic Structure ....| ....

Natural Resources ....| ....
Inventions and Development ....| ....

Power and Energy ....| ....
Work Skills ....| ....

Labor ....| ....
Training and Education ....| ....

Power and Energy ....| ....
Transportation ....| ....

Processes ....| ....
Service Industries ....| ....

Labor ....| ....
Economic Structure ....| ....

Production Systems ....| ....
Service Industries ....| ....

Production Systems ....| ....
Planning and Control ....| ....

Power and Energy ....| ....
Environment ....| ....

Tools ....| ....
Marketing ....| ....

Natural resources ....| ....
Production Systems ....| ....

Natural Resources ....| ....
Training and Education ....| ....

Work Skills
Processes

Power and Energy
Labor

Communication Information
Industrial Organization

Scientific Development
Planning Control

Economic Structure
Industrial Organization

Processes
Occupations

Industrial Organization
Marketing

Training and Education
Service Industries

Inventions and Development
Processes

Planning and Control
Environment

Training and Education
Occupations

Inventions and Development
Marketing

Work Skills
Production Systems

Production Systems
Socialization

Communication Information
Labor

Processes
Socialization

Tools
Planning and Control

Processes
Labor

Inventions and Development
Production Systems

Planning and Control
Socialization

Tools
Occupations

Marketing
Occupations

Power and Energy
Processes

Natural Resources
Work Skills

Materials
Management and Personnel

Environment
Socialization

Economic Structure
Marketing

Service Industries
Environment

Tools
Training and Education

Marketing
Environment

Planning and Control
Occupations

Occupations
Environment

Marketing
Socialization

Management and Personnel
Economic Structure

Power and Energy
Production Systems

Marketing
Training and Education

Labor
Industrial Organization

Marketing
Service Industries

Management and Personnel
Environment

Processes
Planning and Control

Power and Energy
Training and Education

Scientific Development
Management and Personnel

Industrial Organization
Service Industries

Economic Structure
Service Industries

Production Systems
Processes

Work Skills
Socialization

Natural Resources
Environment

Management and Personnel
Economic Structure

Communication Information
Service Industries

Power and Energy
Scientific Development

Transportation
Training and Education

Processes
Transportation

Materials
Processes

Labor
Marketing

Materials
Production Systems

Materials
Economic Structure

Materials
Industrial Development

Work Skills
Scientific Development

Work Skills
Inventions and Development

Inventions and Development
Occupations

Materials
Communication Information

Transportation
Economic Structure

Labor
Occupations

Materials
Marketing

Production Systems
Economic Structure

Communication Information
Economic Structure

Power and Energy
Planning and Control

Transportation
Labor

Materials
Transportation

Tools
Consumer Products

Communication Information
Training and Education

Transportation
Marketing

Processes
Industrial Organization

Labor
Environment

Tools
Communication Information

Materials
Planning and Control

Processes
Management and Personnel

Communication Information
Marketing

Power and Energy
Occupations

Inventions and Development
Socialization

Power and Energy
Industrial Organization

Production Systems
Transportation

Labor
Consumer Products

Processes
Economic Structure

Marketing
Consumer Products

Power and Energy
Natural Resources

Communication Information
Planning and Control

Transportation
Industrial Organization

Labor
Service Industries

Processes
Communication Information

Service Industries
Consumer Products

Inventions and Development
Transportation

Processes
Training and Education

Planning and Control
Service Industries

Power and Energy
Materials

Production Systems
Communication Information

Industrial Organization
Training and Education

Materials
Training and Education

Scientific Development
Industrial Organization

Training and Education
Socialization

Consumer Products
Socialization

Communication Information
Consumer Products

Transportation
Occupations

Inventions and Development
Service Industries

Work Skills
Transportation

Planning and Control
Training and Education

Scientific Development
Economic Structure

Production Systems
Management and Personnel

Processes
Environment

Management and Personnel
Consumer Products

Work Skills
Environment

Inventions and Development
Service Industries

Management and Personnel ....
Socialization ....

Tools ....
Transportation ....

Production Systems ....
Industrial Organization ....

Natural Resources ....
Marketing ....

Production Systems ....
Marketing ....

Materials ....
Labor ....

Materials ....
Service Industries ....

Tools ....
Work Skills ....

Natural Resources ....
Socialization ....

Tools ....
Materials ....

Scientific Development ....
Marketing ....

Communication Information ....
Socialization ....

Transportation ....
Service Industries ....

Natural Resources ....
Consumer Products ....

Industrial Organization ....
Socialization ....

Occupations ....
Service Industries ....

Economic Structure ....
Planning and Control ....

Transportation ....
Consumer Products ....

Labor ....
Socialization ....

Economic Structure ....
Training and Education ....

Inventions and Development ....
Management and Personnel ....

Management and Personnel ....
Marketing ....

Training and Education ....
Environment ....

Tools ....
Environment ....

Transportation ....
Management and Personnel ....

Inventions and Development ....
Environment ....

Tools ....
Service Industries ....

Scientific Development ....
Socialization ....

Tools

Processes

Natural Resources

Service Industries

Management and Personnel

Occupations

Scientific Development

Environment

Inventions and Development

Consumer Products

Industrial Organization

Occupations

Scientific Development

Communication Information

Work Skills

Industrial Organization

Economic Structure

Consumer Products

Management and Personnel

Service Industries

Industrial Organization

Environment

Work Skills

Planning and Control

Scientific Development

Transportation

Industrial Organization

Planning and Control

Natural Resources

Management and Personnel

Production Systems

Labor

Work Skills

Management and Personnel

Inventions and Development

Scientific Development

Tools

Management and Personnel

Work Skills

Occupations

Natural Resources

Industrial Organization

Materials

Consumer Products

Inventions and Development

Consumer Products

Inventions and Development

Occupations

Economic Structure

Socialization

Work Skills

Marketing

Tools

Inventions and Development

Inventions and Development

Industrial Organization

Transportation..
Communication Information ....

Work Skills..
Economic Structure..................................

Planning and Control...............................
Consumer Products..................................

Power and Energy ....
Socialization...

Labor...
Planning and Control................................

Materials..
Scientific Development.............................

Natural Resources...................................
Labor...

Inventions and Development.....................
Communication Information ....

Production Systems ....
Environment...

Work Skills..
Service Industries...................................

Occupations...
Consumer Products..................................

Power and Energy ....
Consumer Products..................................

Materials..
Inventions and Development.....................

Communication Information ....
Management and Personnel ....

Natural Resources...................................
Communication Information ....

Materials..
Occupationns..

Inventions and Development.....................
Economic Structure..................................

Occupations...
Socialization...

Materials..
Socialization...

Inventions and Development.....................
Labor...

Natural Resources...................................
Processes...

Power and Energy ....
Marketing ....

Tools ....
Scientific Development.............................

Transportation..
Socialization...

Work Skills..
Training and Education............................

Inventions and Development.....................
Training and Education............................

Power and Energy ....
Tools ....

Management and Personnel ....
Industrial Organization ....

Service Industries
Socialization

Work Skills
Labor

Natural Resources
Transportation

Economic Structure
Occupations

Management and Personnel
Planning and Control

Power and Energy
Service Industries

Tools
Industrial Organization

Power and Energy
Inventions and Development

Tools
Socialization

Scientific Development
Production Systems

Natural Resources
Occupations

Power and Energy
Economic Structure

Training and Education
Consumer Products

Scientific Development
Processes

Production Systems
Occupations

Tools
Labor

Scientific Development
Training and Education

Production Systems
Training and Education

Materials
Work Skills

Power and Energy
Management and Personnel

Management and Personnel
Training and Education

Economic Structure
Environment

Power and Energy
Communication Information

Natural Resources
Economic Structure

Scientific Development
Labor

Industrial Organization
Consumer Products

Work Skills
Communication Information

Materials
Environment

Transportation..|........
Planning and Control...|........

Processes...|........
Marketing ....|........

Communication Information ....|........
Occupations..|........

You've now completed PART ONE of my opinionnaire -- thanks again.

Before you move on to PART TWO, would you please flip back through the preceeding 9 pages to ensure that you've responded to each of the pairs of characteristics.

OPINIONNAIRE OF PRODUCTIVE SOCIETY

PART TWO

Part Two contains 23 sets of statements. Each set consists of a series of descriptions of a particular characteristic of productive society.

Please examine the descriptions in each set and make two decisions.

1. Which description of a particular characteristic, in your opinion, is the most important one when you are teaching industrial arts.

2. Which description of a particular characteristic, in your opinion, is the least important when you are teaching industrial arts.

Place the letter of the description you choose in the spaces provided with each statement:

_________ is most important

_________ is least important

Sample Question:

When teaching the concept of Research as a characteristic of productive society in my industrial arts class, it is my opinion that content which emphasizes:

____C____ is most important

____D____ is least important

A The utilization of one or two persons to conduct research
B Research is not significantly important
C The use of computers and skilled technicians to conduct research on a comprehensive basis
D The use of research only in educational institutions

If, as in the example, you indicate C as the most important description, then you are telling me that, in your opinion, you believe that content related to the use of computers and skilled technicians to conduct research on a comprehensive basis is most important when teaching about research in your industrial arts classes.

If, as in the example, you indicate D as the least important, then you are telling me that the use of research only in educational institutions is the least important when teaching about research in your industrial arts classes.

PLEASE NOTE

1. Please respond to each set of descriptions about each characteristic, even if in your teaching industrial arts you do not teach that particular characteristic.

2. Make only two choices for each statement: one -- the most important, and two -- the least important.

1. When teaching the concept of Natural Resources as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Development of forests, land, minerals and water resources
B Enforcing the conservation movement and more extensive use of research
C The use of coal and iron
D Use of land for agriculture and forests for structure and fuel

2. When teaching the concept of Management and Personnel as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Existence of bureaucratic control, hierarchial structure and techniques of innovations
B Involvement of managers, foremen, inspectors and a simple authority structure
C One man who controls the entire production

3. When teaching the concept of Communication Information as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A The use of transistor, laser, long distance communication and electronics miniaturization
B Radio, motion picture, television, microfilm, magnetic tape
C Communication by water, rail, telephone, telegram
D Communication by messenger and word of mouth
E Two-way radio, radar, vacuum tube control of equipment

4. When teaching the concept of Materials as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A The use of wood, iron and bronze
B The use of powdered metals, and alloys for greater strength and heat resistance
C The use of steel and copper
D The use of alloyed steels and aluminum alloys
E The use of plastics, super alloys, magnesium and titanium

5. When teaching the concept of Socialization as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Decline of the rural community
B Integration of societies and various cultures
C Leisure time, mass society, modernization, technological influence
D The family group is most important

6. When teaching the concept of Production Systems as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A The use of transfer machines to replace manual material handling
B The use of quality control, inspection, computer controlled production lines and systems organization
C The application of machines to cutting tools which are manually controlled
D Employing systems of mass production, automation and standardization
E The use of simple hand tools, manually operated

7. When teaching the concept of <u>Work Skills</u> as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Skilled inspector and mechanic used where mechanical operations replace the need for machine feeding or tending
B The use of a generally skilled craftsman and unskilled manual labor
C Highly skilled technicians used for increased maintenance and computer programming
D A combination of machine use and skilled craftsman
E The need for technicians, designers and planners

8. When teaching the concept of <u>Training and Education</u> as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A The significance of apprenticeship
B Simple education based upon religion, reading, writing and arithmetic
C The significance of science and mathematics in the process of education
D The use of manual training and some industrial training and general education
E The importance of general education, professionalization, highly skilled industrial training, computer instruction

9. When teaching the concept of <u>Marketing</u> as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Involvement of foreign competition, increased consumption, improved strategies for marketing
B Demand exceeds supply because of poor production techniques
C Small amount of trade with foreign countries
D Emphasis on increasing local and foreign consumption

10. When teaching the concept of Labor as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Labor is characterized by collective bargaining, worker morale, specialization, incentives, work motivation and conciliation
B Labor involves a single craftsman who constitutes the sole form of productivity
C Employee-employer relations are such that there is little regulation of worker time and conditions and the existence of only a few unions

11. When teaching the concept of Power and Energy as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Use of muscle, wind and water
B Use of steam and the steam engine
C Significance of electricity, petroleum, internal combustion engine and portable power
D Development of atomic energy, hydraulic and jet power
E Use of nuclear power, natural gas and solar energy conversion

12. When teaching the concept of Inventions and Development as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A The development of power conversion and mass production of textiles, iron and steel machinery
B Development of scientific and technical research laboratories manned by professional inventors
C Development of certain techniques which include the wheel, extracting process, metal bridges and the use of gasses
D Development of mining, textile machinery and the establishment of modern chemistry to improve processes

13. When teaching the concept of Industrial Organization as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Individual owned and operated business enterprises and the establishment of craft guilds
B Small companies privately owned with little organization control and the need for vast sums of money
C Organization based upon corporations, utilities, public ownership, stock holders, and government control

PLEASE REMEMBER

Each set of statements contains several descriptions of a particular characteristic of productive society. Examine each description and make two decisions.

1. Which description of a particular characteristic is the most important one when teaching industrial arts.
2. Which description of a particular characteristic is the least important when teaching industrial arts.

14. When teaching the concept of Planning and Control as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Characterized by computers, data processing, numerical control, efficiency study, and quality control
B Planning is performed by a single individual using blue printing and simple specifying and no quality control
C The use of some feedback for purposes of data evaluation and processing and mechanization improvement

15. When teaching the concept of Tools as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A The use of simple hand tools for simple operations
B Ultra-high speed computers and machine tools
C Simple machines based upon wheel and shaft principle
D The use of automatic machines to extend simple machines
E The automatic factory was made possible because of precision

16. When teaching the concept of Processes as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Sheet glass, metal drawing, assembly line, extruding
B Bessemer and open hearth steel, hydraulic pressing
C Iron puddling, slip casting, cerventation carburization
D Casting, forging, wood turning and casting on process

17. When teaching the concept of Scientific Development as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Scientific and technological work has become similar and science serves as a basis for further technological developments
B Mathematics is clearly related to science and scientific developments are based upon simple principles
C Certain developments in biology, chemistry and physics do not relate to industry and do not affect it

18. When teaching the concept of Consumer Products as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Household appliances, guarantees, luxury items, synthetic materials
B Emphasis on simple utilitarian and æsthetic goods
C Entrepreneurship, supply sufficient for all demands, retail-wholesale selling

19. When teaching the concept of Occupations as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Occupations are simple and do not involve detailed categorizations
B Specialization, social mobility, job classifications are a part of occupations
C Some occupational structure is evident with influence of class lines

20. When teaching the concept of Transportation as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Short range, small freight movement on land and water
B Use of steamship and train for some continental travel
C Use of large freight carrying aircraft and electronic control of road and airways
D Use of jet aircraft and improved atomic applications
E Use of diesel, conventional aircraft and improved roads for local travel

21. When teaching the concept of <u>Services</u> as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Maintenance and hardware service for small applications
B Service industries such as hospitals, universities, government and domestic
C Not significant

22. When teaching the concept of <u>Environment</u> as a characistic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Physical factors had an influence upon industrialization
B Production techniques had an influence upon industrialization
C Sociocultural factors had an influence upon industrialization
D Production design factor had an influence upon industrialization

23. When teaching the concept of <u>Economic Structure</u> as a characteristic of productive society in my industrial arts classes, it is my opinion that content which emphasizes:

_________ is most important

_________ is least important

A Large-scale capital investment into research and development
B The use of limited outlay and profits with only a few wealthy
C Investment into industry is not important
D Increased productivity caused increased investment
E Large capital investment and public ownership

If you wish to receive a copy of a summary of results pertaining to this questionnaire, please indicate by a check - ☐

Please enclose the completed questionnaire in the self-addressed and stamped envelope and return it at your earliest convenience.

Thank you for your assistance.

Appendix C

Copy of Post Card and Letters

Department of Industrial
and Vocational Education
April 22, 1969

I am working on some research at the University of Alberta which deals with the concept of productive society. Through extensive research, I have identified certain characteristics of productive society. To complete the study I need your opinions regarding the various concepts which I have structured.

A questionnaire has been developed which covers the characteristics and will give you an opportunity to express your opinions regarding the various concepts. Your responses will then be analyzed to determine the opinions of Industrial Arts teachers concerning these characteristics.

Your name, along with 50 other Industrial Arts teachers in Alberta has been randomly selected for this questionnaire. I sincerely hope that you will be able to devote about 45 minutes of your time to respond to the questionnaire. Your responses will be kept strictly anonymous.

The purpose of this letter is to both say "hello" to you and to request your participation in this study. It is important that all of the questionnaires be returned and in the event that you believe you would not be able to participate would you please indicate it to me not later than April 28, 1969.

If I don't hear from you via the postcard I'll be sending you a copy of the questionnaire.

Thank you for your help

Yours Sincerely

L.L.Lewchuk

April 30, 1969

One of the ways in which improvement in educational curricula comes about is through research. Perhaps the persons having the most influence on the actual learning situation are the teachers. It seems logical, therefore, that initial research in industrial arts should concern itself with the opinions of teachers.

Mr. Lewchuk, through a review of historical and contemporary writings, presents us with one reliable method of structuring the world of work or productive society. In categorizing such a fuzzy phenomenon, he has of course lost many of the specific elements included. But of the many possible methods of structuring productive society he does present us with one acceptable categorization.

It would be foolhardy at this time to predict what effect, if any, Mr. Lewchuk's research will have on industrial arts curriculum. But we do know that the study will lose much of its potential both for objective discussion as well as further research if the returns to his questionnaire are small.

Your response to the questionnaire is equivalent to that of 15 teachers in an industrial arts laboratory very similar to yours. I request your assistance to his project and thank you in advance for it.

Yours Truly

James E. Gallagher

Associate Professor

Department of Industrial and
Vocational Education
University of Alberta
May 14, 1969

Approximately a week ago you received in the mail a copy of an opinionnaire relating to productive society in which you had an opportunity to respond to the various concepts outlined. Many of the opinionnaires have been returned, but statistical analysis cannot begin without all of the possible responses.

My records indicate that some responses are still outstanding. My project cannot be completed without having responses from all of the teachers involved. If you have not previously had the opportunity to do so, I would ask you to complete and mail the opinionnaire at your earliest convenience. The task may appear enormous at first, but please remember not to spend too much time over any one question. Let your initial thoughts be the guide to your response. I realize that your time is valuable and that you may have pressing problems as the school year draws to a close. However your co-operation in this matter will be greatly appreciated.

If you have already responded to the opinionnaire and mailed it, please disregard this letter.

Thanks again.

Yours truly

L.L.Lewchuk

1. I will respond to the questionnaire ______________

2. [illegible] ______

____
Signature

L. L. LEWCHUK
DEPARTMENT OF INDUSTRIAL AND
VOCATIONAL EDUCATION
UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA

Appendix D

Chart on Back Cover in an Envelope

THE FIVE AGES OF PRODUCTIVE SOCIETY

INFLUENCE OF TECHNOLOGY

EARLY FORMS OF PRODUCTIVE SOCIETY

IMPORTANT CHARACTERISTICS OF PRODUCTIVE SOCIETY IN DOMINANT AGES	Modern Craft Age 1400	Machine Age 1785	Power Age 1870	Atomic Age 1953	Cybernetics Age 1964
Power & Energy	Muscle, wind and water	Steam, steam engine, line shaft transmission, compressed air	Electricity, petroleum, internal combustion engine, diesel, turbine, portable power	Atomic energy, petroleum, hydraulic power, jet power	Nuclear power, natural gas, chemical-physical power, solar energy conversion
Natural Resources	Land (agriculture) Forests-structure -fuel	Coal Iron	Development of forests, land, minerals and water resources	Enforcing of the conservation, movement to curb shortages, more fully developed use of research	
Tools	Simple hand tools	Simple machine, extension of hand tools, wheel and shaft, metal lathe and planer	Automatic machine, extension of the simple machine	Automatic factory, precision became very significant	Total automation, numerical control, ultra-high-speed computers and machine processes
Materials	Wood, iron, bronze	Steel, copper	Alloyed steels, aluminum, light alloys	Plastics, super alloys, magnesium, titanium	Powdered metals, more new metal alloys for greater strength and heat resistance
Work Skills	All around skilled craftsman, unskilled manual laborer	Machine replaced skilled craftsman, need for technically skilled personnel	Skilled inspector & mechanic, mechanical operations replace need for machine feeding or tending	Engineers, designers, skilled technicians	Highly skilled technicians for increased maintenance and computer programming
Inventions & Development	Wheel, paper, smelting, needle compass, spinning wheel, water wheel, colonization and domestic production	Iron plow, steam, factory and manufacture, engine application, interchangeable parts, cylinder printing press, camera, telegraph, rubber products	Steel making, celluloid, automobile, cement, X-ray, portable power plants, skyscrapers, vacuum tube, total mechanization and electrification	Automation and feedback control; professional scientist, engineer, researcher; collaborate to create and develop new and improved products, machines, and tools	
Scientific Development (Biology, Physics & Chemistry)	Little or no scientific development, only simple scientific principles, applied to industrialism		Inorganic, organic chemistry, conservation of energy, electron, radio activity, atomic structure, electromagnetism, isotopes, genetics	Closer control of material development, more accurate and rational methods of scientific development. New and improved developments	
Production Systems	Simple one-man or family-owned system, use of simple hand tools	Use of machine and cutting tools, manual control, no evidence of quality production	Transfer machines used to replace manual material handling, beginning of mass production	Mass production, automation, standardization	Quality control, computer controlled production lines, systems organization, data storage
		F A C T O R Y			
Processes	Casting, forging, wood turning	Iron puddling, slip casting	Machining, hydraulic pressing, bessemer & open hearth steel, extensive power applications	Sheet glass and metal drawing, refrigeration, synthetization, continuous assembly line, sintering, extruding, molding, die casting, modern metallurgy	
Transportation	Walking, use of animals, sailboat, earth road and waterway, short range	Steam train, steam ship, steel rails, ocean way, continental travel	Automobile, diesel locomotive, airplane, improved roads, suburban, rural, continental travel	Jet air plane, helicopter, stratosphere travel, atomic ships and trains	Rocket, SST airplane, very large freight carrying air craft, electronic control of airways and roads
Communication Information	Word of mouth, messenger	Mail by water and rail, newspapers on steam press, telephone, telegraph	AM and FM radio, motion picture, television, micro-film, magnetic tape	2-way radio communication, radar, electronic computers, vacuum tube control	Transistor, laser beam, maser, long distance and interplanetary communication, electronics miniaturization
Labor	Simple craftsman with some apprenticeship, low productivity	Beginnings of employee-employer relationships, no regulation of worker time and conditions, mechanization, increased productivity, beginnings of unions		Strikes, collective bargaining, worker morale, more significant division of labor, specialization, incentives, work motivation, conciliation	
		D I V I S I O N O F L A B O R			
Management & Personnel	One craftsman controlled entire operation, usually family owned, small output	Managers, foremen, inspectors; some hierarchial structure became apparent; authority structure increased		Significant increase of bureaucratic control, hierarchial structures, control of complete production systems, technicians important for innovations	
Economic Structure	Little or no investment, few profits for working class, large profits for select few	Limited outlay, limited profits, few wealthy	Development caused increased productivity which caused increased investment into productivity	Large capital investment for automation facilities, public ownership	Tremendous capital investment into research and development to increase productivity, overcome competition
Industrial Organization	Usually one individual owned and operated a small business enterprise, establishment of craft guilds, few industries established		Small companies, private enterprise, little organization control, evolution of mass industries	Large corporations, mergers, utilities, public ownership, government control and participation, stocks, bonds, stockholders, reinvestment, operations research, simulation	
Marketing	Demand usually exceeded supply	Trade with foreign markets	Improved economy, increased local and foreign consumption	Competition with foreign countries, increased population, increased consumption, improved strategies for marketing, advertising, consumer education	
Planning & Control	Planning performed by one or several craftsmen, little or no quality control, beginning stages of blue-printing drawing and specifying		Mechanization which employed feedback, effective methods of data evaluation and processing	Data processing and computers for design, efficiency study, controlled layout and plant manufacture, preparation and installation of computers, numerical control, quality control, standardization	
Training & Education	Simple, not involved; slow process; religion; reading, writing, arithmetic	Apprenticeship became more significant	Beginnings of industrial training programs, more general education, manual training	More efficient and effective education, sciences and maths more important	Professionalization, significant general education, specialized industrial training, computer instruction, social sciences
Occupations	Occupations as known in the Cybernetics Age were not prevalent; simple occupations existed, mainly within the craft guilds and agriculture		Some occupational structure, existence of class lines	Occupations become more diversified as specialization increases, social mobility is a significant social factor, hierarchy of occupations, every type of "job" classified	
Services	Not significantly present as known in the Cybernetics Age		Some maintenance and hardware service but not fully realized	Service industries resulted from production industries, stronger during the 1960's, domestic and hardware service, significant involvement of maintenance	
Consumer Products	Peasant type with emphasis on the utilitarian, royal type with emphasis on the aesthetic aspect		Retailing, wholesaling, entrepreneurship, supply sufficient for all involved	Household appliances, guarantees, general luxury items, trade-ins, synthetics replace natural materials, chain stores, quantity production	
Environment	FOUR FACTORS HAD AN INFLUENCE UPON INDUSTRIALIZATION 1. Physical 2. Sociocultural 3. Production techniques 4. Production design				
Socialization	Family group most significant	Decline of rural community	Integration of societies and various cultures	Material goods as status symbols, leisure, individual adjustment, suburbia development, mass society, cultural diversity, influenced by technology, modernization	

PRESENT DAY PRODUCTIVE SOCIETY

Solar cell - stored energy - world economy
Nuclear reactor - steam production - electrical production
Fuel cell - efficient - low cost

- Conservation of minerals, land, forests, water, petroleum
- Development of shale oil, tar sands, coal deposits, poor qualities of ore deposits
- Use of U-235, plutonium
- Use of water for hydro-power
- More research and development

MACHINE TOOLS: Screw cutting lathe, Drill press, Boring mill, Planer, Measuring instrument, Milling machine, Band saw, Grinder, Holding attachments

PRECISION

Operated by electricity, hydraulics, pneumatics, electronic control

- Research and development
- More new chemicals
- Synthetic diamonds
- Plastics, more diverse manufacture of petrochemicals, heavy water, hydro-carbons, antibiotics

Professional, Technical, Skilled, Semi-skilled, Unskilled, Manual

- Specialization
- Laboratory research
- Technical expertise
- Systems approach
- Manipulations not "back breaking"
- Integration with other human beings

- Inventions more sophisticated as a result of science and technology
- Developments benefit society
- Developments cause and take advantage of change
- Acceleration of change and technology

FACTORY ORGANIZATION

President; Vice Presidents; Secretaries, Sales, Finance; Managers; Accounting, Engineering, Personnel, Research, Clerks; Draftsmen; Research Men; Operators: Drill Press, Grinder, Lathe, Milling Machine, Shaper, Foundry; Plant Sup't; Assembly; Inspectors; Packing and Shipping; Storage

- Synthetics, hormones, accelerators, silicones, wave & quantum mechanics
- Uranium fission, neutron, protein structure, nucleon structure
- Radio astronomy
- Modern electronics

- Detailed electronics development
- Magnetic tape photography
- Televised telephone
- Talking book or newspaper
- Transistors, computer controlled printing

- Research and development
- Electro metallurgy
- Magnethoydrodynamics
- Numerical control
- Greater strength materials
- Synthetic parts

DIVISION OF LABOR

Administration, Research, Sales, Accounting, Authority Structure, Specialization, Relations With: Government, Community, Business

- Ground effect machines
- Long range cargo carriers
- Gas Turbine for trucks
- Conveyer, pipelines
- Electronic controlled traffic
- High speed highway systems

ORGANIZATION OF MANAGEMENT

Formal Organization: President; Board of Directors; Top Management; Sales, Accounting, Manufacturing, Engineering, Public Relations; Division Chiefs; Maintenance, Manufacturing, Inspection; Department Chiefs; Assembly – Foremen – Workers; Production – Foremen – Workers

Informal Organization: Interaction Between
- Top Management
- Managers & Superintendents
- Specialists & Supervisors
- Clerical Office Workers

CONSUMPTION – PRODUCTION – INCOME SHARING

CORPORATIONS BIG BUSINESS: Stockholders, Board of Directors, Investment, Mergers, Government Control, Public Ownership, Productivity Measure, Bonds, Stocks, Operations Research

FACTORY SYSTEM

Consumer Market, Labor Market, Money Market, Goods & Products

Operate In
- Self-controlled, Traditional, Administered, Contested, and Free or Marginal Markets

IDEA TO FINISHED PRODUCT

Production Planning, Design, Tooling, Production

- Professional programs and standards
- Develop student readiness for a vocation
- Access to industries, labor unions, community resources
- Labor and industry expectations of voc. ed.
- Educational programs for expertise
- Occupational guidance
- Coordinating education and technology
- Post-secondary utilitarian education

- White collar and blue collar workers
- Clerical and kindred workers
- Manual and service workers
- Farm workers professionalization

INDUSTRIAL BASE

Basic Activities: Producing Goods and Services for Sale Outside the Community
Service Activities: Internal Consumption Only

- Mass advertising creates new thoughts, new desires, and new actions; formation of business and trade associations
- Common standard developed
- Status symbol of goods possessed or consumed
- Role of housewives changed
- All goods directly or indirectly for consumption
- Leisure time goods - variety
- "Do-it-yourself" products
- Consumer credit
- Supermarket, competition on local scale

ENVIRONMENT

Physical, Sociocultural, Production Techniques, Production Design

- Affluent society
- Work-and-save obsolete
- Sociotechnical behavior
- Public relations
- Occupational status
- Interaction & communication
- Formal & informal organization
- Individual identity & adjustment
- Group belongingness
- Social mobility
- Social stratification